

NATIONALGEOGRAPHIC.COM/MAGAZINE

JUNE 2004

NATIONAL GEOGRAPHIC

THE END OF CHEAP

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BY SARAH LEEN

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ON THE WEBSITE

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- SIGHTS & SOUNDS** Experience the life of a Shiite in Iraq.
- VIDEO** Explore the underwater world of Monterey Canyon.
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OnScreen & Online

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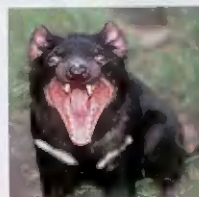
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NG Television & Film



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Terrors of Tasmania Unearthly growls and a mouthful of nasty teeth give the Tasmanian devil its fearful name. But as biologist Menna Jones discovers in her study of the solitary, nocturnal, beagle-size marsupial, the devils raise havoc mostly with themselves—and usually only at mating time.

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THE SHIITES OF IRAQ

SIGHTS & SOUNDS Experience the world of Iraq's Shiites through the eyes and ears of photographer Matt Moyer. ■ **ONLINE FORUM** Are Iraqis prepared to take over? Air your opinions on this and other subjects covered in this issue. nationalgeographic.com/magazine/0406



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From the Editor



RUSSELL LEE, LIBRARY OF CONGRESS

One wilting Texas summer I directed a bulldozer clearing paths for oil crews—and learned to read a compass and watch for rattlesnakes at the same time. It was all part of growing up in the “oil patch,” where refinery flares burned 24 hours a day and the shining lights of drilling rigs at night looked like obelisks honoring risk and wealth (that’s Kilgore, above, about 30 miles from my family’s home). Talk about cheap oil: With no need to conserve, service stations fought gas wars, cutting prices to 19 cents a gallon.

No more. Sure, oil is still relatively cheap (though it may not feel that way at the pump). The problem is the world’s appetite for oil just won’t quit, be it in China or here in the United States, the world’s top consumer. Will we run out of oil? Depends on how much we’re willing to pay for it. And not all the costs are obvious: We pay in our foreign policy, for example, and in military expenditures. Yes, we’ll see more exploration and exploitation of oil sources that were once considered economically unviable. But no matter how good we get at finding and extracting the stuff, the era of cheap oil is coming to an end because global production of conventional oil will peak and then slowly decline. How soon? Turn to page 80 to find out.

Bill Allen

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Forum

February 2004

"The Case of the Missing Carbon" drew the largest response this month. Like most of our stories on the environment, the article provoked letters from readers with widely divergent points of view. Some were outraged at what they concluded were wasteful human activities that contribute to global warming; others were skeptical that human-induced global warming even exists.



Case of the Missing Carbon

Global warming is a reality, not a theory. People who continue to stick their heads in the sand and pretend it isn't a problem are a big part of the problem. The issue needs to be addressed at the highest levels immediately, but governments and corporations that are making the most of the status quo aren't willing to change. I pity our children and grandchildren: The world they inherit may be broken beyond repair.

ROBERT SCHUTZNER
Kent, Washington

FROM OUR ONLINE FORUM

nationalgeographic.com/magazine/0402

The world is getting warmer. We flatter ourselves to imagine we can be the cause or the cure. I think we are in the early stages of learning about this Earth of ours. I have a lot of questions

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that need answers before I am willing to change my lifestyle or handicap my country for a theory.

C. J. CONDON
Maquoketa, Iowa

The view that "If nature withdraws its helping hand . . . we could be facing drastic [climate] changes even before 2050, a disaster too swift to avoid" is unnecessarily pessimistic. Of course, if we don't take action until too late, then disaster would be unavoidable. But not if we start now. We need to reduce our emission of carbon. The belief that such action is inconceivable has to be eradicated.

The sooner people overcome this notion, the sooner policy can start to deal with the problem.

CALLUM JOHNSTON
London, England

Your recent issue with the article on the carbon cycle and global warming arrived in January. Considering this January has been one of the coldest on record in New England, you'd have a hard time convincing anyone here that there's a warming problem!

BOB CLERE
Bolton, Connecticut



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Geographica: Trail of Tragedy

I was fascinated by your map of the recovery of debris from *Columbia's* tragic demise. How fitting that the recovery and cataloging of her remains were as high-tech as the work that she and her crew did in orbit. I think it is notable that neither *Columbia* nor *Challenger* were lost due to design flaws in the space shuttle orbiter itself, but to faults in the booster and fuel tank that propelled and fueled them into Earth's orbit. Those items were designed as a compromise with an eye toward cheapness.

RON SMITH
Ambler, Pennsylvania

NASA's ineptitude on shuttle safety can no longer be tolerated. The sobering truth is that



NASA

the space shuttle is unsafe, obsolete, and should be replaced. NASA should design a new spacecraft with a foolproof escape-pod system. Astronaut safety must take top priority.

RICK SCHREINER
Pasadena, California

You did a great job of noting the contributions of NASA, FEMA, EPA, and the Forest Service in the shuttle *Columbia* recovery effort. You failed to

mention the role of the first responders—local and state law-enforcement people and the citizens of East Texas who started reporting the location of debris as soon as it fell from the sky.

A. KIM LUDEKE
Austin, Texas

The statement about "thousands of Forest Service firefighters walking in lines to spot debris" didn't do them justice. They encountered poisonous snakes and spiders, received cuts from brush and barbed wire, were stung many times by wasps and bees, and were harassed by farmers' vicious dogs. It makes one proud to see that so many people responded to this catastrophe from all over the nation.

GARRETT M. STONE, JR.
Redondo Beach, California

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Shame on you. How can you justify running that atrocious back cover ad for the Infiniti QX56 SUV in the same issue with "The Case of the Missing Carbon" (other than an insatiable thirst for the almighty advertising dollar)? It is ironic and prophetic that the article warns that "like a finger on a balance, our steady contributions are throwing the natural [carbon] cycle out of whack" while the ad's tagline reads, "Accelerating the future." This is like running a cigarette ad in a

health publication. But we're not talking about the dangers of secondhand smoke to nonsmokers; we're talking about a very real threat to every living organism on our ailing planet.

PATRICK TIMOTHY MULLIKIN
Montpelier, Vermont

The words on the pictures on pages 110 and 111 imply that the stacks of the Georgia power plant are belching carbon-laden smoke, when in fact they are cooling towers emitting harmless water vapor.

JEROLD NOSS
Toledo, Ohio

The land-clearing fire in the photo on page 111 is producing visible smoke, but, as several observant readers noted, the four cooling towers in the photograph of Plant Bowen, a coal-burning

facility near Cartersville, Georgia, are producing water vapor. The taller tower in that photo (its top obscured by vapor) releases CO₂ as a by-product of coal burning. Facilities like Plant Bowen account for 80 percent of the annual human contribution to CO₂ emissions.

Han Dynasty

My surname is Liu, so I was glad to read about the Han dynasty, which was started by the Liu family. The story of Wang Mang, who usurped the dynasty for 14 years, was most interesting. This was the reason for a long tradition in China that Liu men did not marry women from Wang families—the women would bring disaster. My mother was from a Wang family, and some people predicted disaster when my parents got married.

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Somehow my family prospered. When I was young, I thought this type of superstition based on past history was silly. As I get older, I realize that maybe it's not so bad: Memories like these generate interest in our heritage.

PINGHUI V. LIU
Boca Raton, Florida

I was impressed by the art in the Han dynasty article. Would you let me know where I could see more of Hongnian Zhang's work.

ORTHO FAIRBANKS
Salt Lake City, Utah

Our article on China's Bronze Age in the July 2003 issue featured some of Zhang's paintings; there's also a short piece about his canvases in Behind the Scenes in the same issue. You can find out more about Zhang and his work at fletchergallery.com and zhangwoolley.com.

If you were going to use Longfellow's poem at the start of your article, somebody should have read past the first two lines:

"Under a spreading chestnut tree
/ The village smithy stands;
/ The smith, a mighty man is he,
/ With large and sinewy hands."
"Smithy" is to "smith" as "bakery" is to "baker," so you would have the building pounding on the red-hot hoe!

KENNETH F. KINSEY
Geneseo, New York

We plead poetic license. What's more, some dictionaries give two definitions for smithy: a workshop or a blacksmith.

Phoenix Islands

I was encouraged by Gregory Stone's statement that scientists had discovered six new species of coral and fish while diving in the reefs. It's great to know that in spite of the damage done to our

NASA's ineptitude on shuttle safety can no longer be tolerated. The sobering truth is that the space shuttle is unsafe, obsolete, and should be replaced. Astronaut safety must take top priority.

environment because of man's carelessness, there are still ecosystems that continue to thrive every day. It has given me hope that one day my kids will be able to enjoy our planet in its God-given beauty.

ZACHARIE WRIGHT
Costa Mesa, California

Polar Bears

Norbert Rosing's many photographs of polar bears over the years have been most welcome, and convince me even more that we must protect this beautiful, powerful animal. Not only do I believe that Rosing must be, at least, an honorary Canadian, I'm convinced that the incredible polar bear should be our country's national emblem rather than that broad-tailed rodent, the beaver.

JOHN MACKINTOSH
Toronto, Ontario

Do It Yourself

I had to smile when I noticed an item in Do It Yourself encouraging the reader to "ride

customized, big-wheeled tundra buses" to get close to polar bears. Yet the 3 Lessons column on the right side of the same page cautioned readers to "Keep your distance" because bears can destroy a pickup tire with one bite.

JUDITH WESTON
Menlo, Iowa

The tundra buses used to help visitors get close-up views of Churchill, Manitoba's polar bears have enormous, thick-treaded tires that bears can't puncture. That's one of the reasons why tundra buses are the only safe way to get close to polar bears in the wild.

ZipUSA: Greenwich, Connecticut

You owe Greenwich an apology. Your photographs portray Greenwich as an Aryan nation of superwealthy shoppers. Your photos were mainly rich white blond women. You took a very small part of the population and made it seem to the world that a majority, if not all, of the citizens are like the people portrayed in your article. We are not all super-rich. We do not all drive Bentleys and race yachts. There are many blacks, Hispanics, and Asians living here too. Greenwich is not a whites-only shopping utopia.

ROBERT GOTTLIEB
Greenwich, Connecticut

As with all our zip code stories, the Greenwich article focused on a single zip code, 06830, where the median family income is more than \$100,000 and almost half the homes are worth a million dollars or more.

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DAN WOLF
JG. 1939
DEPORTIERT 1941
RIGA
ERMORDET

HIER WOHNTE
OLGA WOLF
JG. 1910
DEPORTIERT 1941
RIGA
ERMORDET

HIER WOHNTE
FANNY BERLIN
GEB. MEYER
JG. 1878
DEPORTIERT 1941
RIGA
ERMORDET

APHICA

CREATURES OF OUR UNIVERSE

HISTORY

Embedded Memories

In Germany, Holocaust memorials hit close to home

On Saturday, December 6, 1941, Nazis ordered the Wolf family onto a train. From their home in Hamburg, Germany, two-year-old Dan and his mother, Olga (right), and Olga's mother, Fanny Berlin, were deported to a concentration camp in Riga, Latvia, 600 miles away. There, they were killed—three out of roughly six million Jews who perished in the genocidal fury of Hitler's final solution.

Sixty years after the D-Day invasion turned the tide of war against Hitler, the names of Dan, Olga, and Fanny have been returned to Flamburg, etched on brass plaques embedded in the sidewalk outside Eppendorfer Baum III, where the Wolfs lived. The markers are part of a Holocaust memorial project conceived by Gunter Demnig, a 56-year-old sculptor from Cologne who became concerned that some Germans were losing sight of crimes committed in their backyards.

"You can open a book and read that the Nazis killed six million Jews, along with five million others, but you still cannot fully realize what happened," says Demnig. "But if you learn the fate of one man or one woman who lived in one particular house—it's very different."

Demnig calls his plaques *stolpersteine*, or stumbling stones, because pedestrians who notice them have their memories tripped: A stroll down an ordinary city street is suddenly



ASMI & HEINZEL, FAMILIENBIBLIOTHEK JÄNDOWE, HEINER MÜLLER-KELZNER

transformed into a walk across the stage of history.

Since 1997 Demnig has installed 3,300 brass plaques in 30 German cities—and in the process has clearly struck a nerve. Students have volunteered to conduct the archival research that's required before each plaque can be etched and put in place. Who lived where? When were they born? Where did they die? Other people have requested *stolpersteine* for friends or family members. The price, 95 euros (\$118 U.S.), barely covers the cost of a plaque's creation and installation. Despite 300 back orders, Demnig has expanded the project to Austria and France.

Yet some Germans want no part of it. According to Demnig, one man in Cologne went to court to prevent installation of

stolpersteine outside his house because, he argued, the plaques would decrease the property value by 100,000 euros. In Munich Charlotte Knobloch, president of the Israelite Congregation, objects to the stolpersteine for other reasons. "Given the fact that Jewish people have been kicked with boots in the past," she says she doesn't want to see "their names again kicked with boots and made dirty."

Despite the objections, Demnig pushes on with the project. "For some people in Israel and elsewhere the stolpersteine are the first reason they've revisited their former homes in Germany," he says. Unlike Berlin's five-acre Holocaust memorial, which will capture the staggering scale of the Nazi genocide when it opens next year, the stolpersteine give mourners a place to remember an individual life.

For 28-year-old Dan Wolf—namesake and nephew of the



two-year-old boy taken in 1941—his family's stolpersteine were one stop in a rediscovery of his Hamburg roots. His great-grandfather Leopold (above, at center) and great-granduncle, Ludwig Wolf—at right, with their sister Flora in the family shop—were part of a cabaret trio whose songs and shtick were the rage in Hamburg in the early 1900s. "My grandmother never told me I came from a long line of showbiz people," says Dan,

a rap singer and actor himself.

"History feels safer when we put it in a museum," he says. "But in Germany the Holocaust happened in the streets, in the marketplace. Any spot might be an unmarked grave."

—Alan Mairson

WEBSITE EXCLUSIVE Find links to related sites selected by our Research Division ■ nationalgeographic.com/magazine/0406.

ODD JOBS

A Dentist for All Species

Name: Peter Kertesz (right, with extracted brown bear tooth)

Job: Multispecies dentist

Patients: Humans, elephants, gorillas, lions, camels, walruses, bears, and more

Author: *A Colour Atlas of Veterinary Dentistry and Oral Surgery*

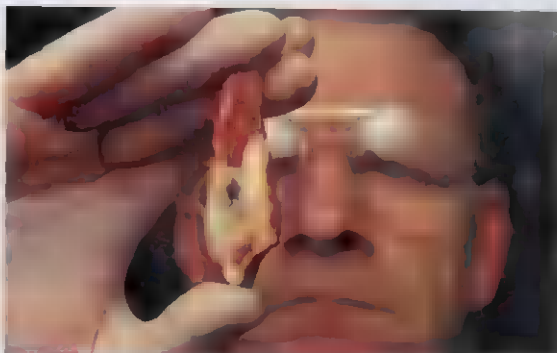
Practice: London; zoos and wildlife parks worldwide

Tools: About 1,500 pounds of custom-made equipment.

Largest drill bit measures 4.25 inches in diameter.

First nonhuman patient: A domestic cat in 1978

Largest patient: "Boy," an Asian elephant in the Kiev Zoo. Extracted tusk (six inches in



diameter) and filled a cavity
Smallest patient: African bush baby, a squirrel-size primate

Toughest procedure: Extracting an aardvark's infected molars, which required cutting through the animal's cheek

Easiest procedure: Brushing his dog's teeth every day with meat-flavored toothpaste

His human patients' reaction: If he can work on a tiger's tooth, then human teeth must be child's play.
—Whitney Dangerfield



Palms Grow in the Gulf

Dubai branches into tourism with man-made fantasy islands

They're actually visible to the naked eye from space: two palm-shaped artificial islands in the Persian Gulf, one three miles across (above), the other four and a half. For Dubai, the Palms, as they're officially called, are keys to the future.

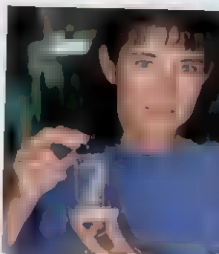
Once a minor trading port, this city-state in the United Arab Emirates rose to prominence as the Arabian Peninsula's flashiest

metropolis, thanks in part to oil discoveries in the 1960s. But petroleum reserves are expected to dry up within 20 years, and the push is on to convert to an economy based on sun and fun.

One problem: Much of Dubai's 45-mile coastline is lined by ports and other facilities, so beaches for development were scarce. Not anymore. The two islands, each built of more than

130 million cubic yards of rock and sand, will create 75 miles of shoreline and feature houses, hotels, and a marine park. The first island will welcome guests by early 2006, the second in 2007. Already thousands of wealthy Middle Easterners and Europeans have bought homes here, betting the scene on the ground will compare favorably to the view from space. —Chris Carroll

My Seven



Choose the Right Seafood

Carole Baldwin *Marine Biologist, Smithsonian Institution*

Unsound fishing and farming practices are straining the seas' resources. But what can you do about it? Plenty, says Carole Baldwin, co-author of *One Fish, Two Fish, Crawfish, Bluefish: The Smithsonian Sustainable Seafood Cookbook*. The right choice at a market or restaurant can make for a safer, less wasteful harvest. Try taking a seafood buyer's quiz.

1 Chilean sea bass or sablefish?
They have a similar taste, but Baldwin says sablefish, caught in well-managed fisheries in Alaska and Canada, is the better choice. Overfished Chilean sea bass (aka Patagonian toothfish) are often the victims of poaching.

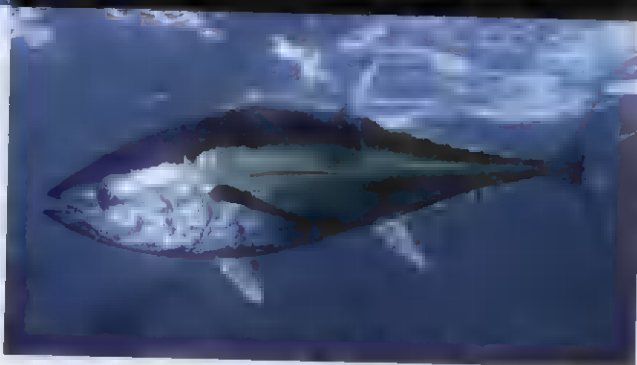


PHOTO: JEFFREY M. HARRIS/ISTOCKPHOTO.COM; (THIS PAGE) JEFFREY M. HARRIS/ISTOCKPHOTO.COM

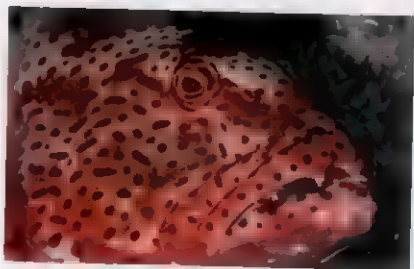
2 Imported or U.S. shrimp?
Choose U.S. shrimp (or crawfish). Some overseas coastal farms keep their overcrowded shrimp disease-free by treating them with chloramphenicol—a potent antibiotic with no known safe level of human consumption.

3 Mahimahi or orange roughy?
Pick mahimahi, ■ short-lived species. Orange roughy, which can live more than 100 years and reach sexual maturity late, can't reproduce fast enough to keep up with market demand.

4 Bluefin tuna (above) or yellowfin? Buy yellowfin. Bluefin catches have plummeted 93 percent since 1963. Look for "troll-caught" on the label. Otherwise the tuna may have been caught on longlines with thousands of baited hooks, which kill seabirds, sea turtles, and other bycatch.

6 Wild or farmed oysters, mussels, and clams? Farmed. Some wild shellfish are caught with dredges that destroy bottom habitats.

7 Grouper (left) or farmed catfish? Catfish are grown in inland farms that have little impact on coastal ecosystems. Grouper are overfished in the wild.



5 Wild Alaska salmon or farmed Atlantic salmon? Go wild. Crowded salmon farms can breed disease and pollute coastal waters.

WEBSITE EXCLUSIVE

Find recipes from marine biologist Carole Baldwin's sustainable seafood cookbook ■ nationalgeographic.com/magazine/0406.

Do It Yourself

THE NATIONAL MALL, WASHINGTON, D.C. (SEE PAGE

TRY IT AT HOME

Honoring WWII Service, Online

The new National World War II Memorial on the National Mall doesn't have room to fit the names of all those who fell. But you can still honor individuals who helped win the war, whether they served on the front lines or on the home front. Enter names of friends and family members—living or dead—who contributed to the war effort at the memorial's website, wwiimemorial.com, where you'll find a searchable WWII Registry.



GO THERE

Off the Mall

If you come to Washington to see the sights on the Mall, don't overlook other nearby (and less visited) National Park sites:

■ **Frederick Douglass Home**, Washington, D.C. This national historic site (below) in the Southeast neighborhood of Anacostia memorializes the great 19th-century abolitionist who, born a slave, bought his

freedom from fees he earned from lecturing against slavery.

■ **Fort Washington**, Fort Washington, Maryland. Built in 1824, on the Potomac River 30 minutes south of D.C., the fort was the only major stronghold defending the capital until the Civil War.

■ **Claude Moore Colonial Farm**, McLean, Virginia. Park workers here dress as tenant farmers, circa 1771. You can watch, ask questions, or even pitch in and help.

For more information go to nps.gov/nro.



PHOTO: © JEFFREY M. HARRIS

PICKS

3 calm spots

In his 20 years at the National Capital Parks—the collection of parks in Washington that includes the National Mall—recently retired superintendent **Arnold Goldstein** learned how to get away from the crowds. Here are his favorite oases of calm and around the Mall. You can find them on the tear-out map facing page 88.

- **The FDR Memorial at night** Most people visit during the day, but the site's waterfalls and statues are beautifully lit—and perhaps more moving—after sundown.
- **Constitution Gardens** Tucked between the World War II and Vietnam Veterans Memorials, there's a secluded island with a memorial to the 56 signers of the Declaration of Independence.
- **The Tidal Basin when the cherry trees aren't blooming** Spring blossoms bring hordes of tourists to see the cherry trees (gifts from Japan), but a walk around the Tidal Basin in summer offers quiet, shade, and lovely views.

WEBSITE EXCLUSIVE

Come visit us! Get more travel tips from our staff in D.C. at nationalgeographic.com/magazine/0406.

Behind
the

SCENES

AT THE NATIONAL GEOGRAPHIC SOCIETY

Music Melts a Camel's Heart

Global film audience
for *Weeping Camel*

A nomadic Mongolian family is troubled: One of its camels has rejected her newborn, a rare white calf. Recalling an ancient ritual, the family sends two young boys to find a musician (right, at left) whose playing, they believe, can bring the negligent mother to tears and coax her into nurturing her baby.

Byambasuren Davaa first heard of this seemingly magical practice as a city child in her native Mongolia. As a student at Munich's Academy of Television and Film, she and fellow student Luigi Falorni witnessed it when they spent a spring in the Gobi desert filming *The Story of the Weeping Camel*. "The nomads have ways of communicating with their animals by singing and playing instruments," says Byambasuren. "Music can convey emotions and show affection, things an animal can sense."



The film also explores the tension that results when traditional nomadic life is confronted by Western influences, but Luigi says its main message lies elsewhere. "The nomads' whole culture revolves around helping each other. That's such a good message for all of us."

Presented by THINKFilm in association with National Geographic World Films, our new specialty label, *Weeping Camel* is making the rounds at international film festivals and showing in theaters worldwide. For a list of venues, go to nationalgeographic.com/weepingcamel.

Treasures From Egypt's Past

For decades priceless antiquities lay in the basement of the Egyptian Museum and storerooms across the country gathering dust. Now the treasures, along with pieces of King Tut's collection, like the jeweled pendant of the falcon god (right)—and tales of their discovery—fill the pages of *Hidden Treasures Ancient Egypt*, an opulent new National Geographic book by renowned Egyptologist Zahi Hawass. Available at bookstores or at nationalgeographic.com.



Update: Afghan Fund

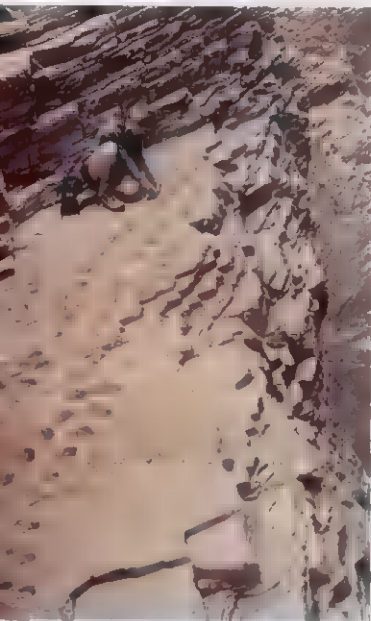
When we found Sharbat Gula in 2002, 17 years after her haunting young eyes first peered from the cover of the *GEOGRAPHIC*, she had daughters of her own. She said she dreamed of them receiving an education, a practice forbidden under Taliban rule. So we established a fund fueled by the public donations that poured in after Sharbat's reappearance.

The \$900,000 collected helped create the NG Girls' Education and Training Center in Kabul (right), which we opened in October 2002 with our partner, the Asia Foundation. The 270 girls here, ages 12 to 17, are catching up academically so they can reenter local schools. They're also learning vocational skills and receiving meals and medical care. Continuing our partnership with the



STEVE McCURRY

Asia Foundation, we're in the process of rebuilding another Kabul girls school and constructing a new library to serve the city's women. To contribute, see nationalgeographic.com/help.



DAN MALACHUK

Tracks in Time

Explorers find 265-million-year-old animal trails

The Grand Canyon's nearly vertical landscape is "a great open book of geologic history," says canyon guide and writer Scott Thybony. Last year Scott and a team of veteran canyon explorers added their own page to that book with funding from the National Geographic Expeditions Council.

Their objective: Search the sheer Coconino sandstone cliffs of Marble Canyon—a stretch along the Colorado River south of Lake Powell—for tracks left by prehistoric creatures. "There may be hundreds of fossilized track sites in the Grand Canyon," says team member and geologist Christa Sadler (left). "But they'll never be seen because of their remote location."

Trekking, rappelling, and scrambling for one harsh spot to the next, the team was finally rewarded. In an area of Marble Canyon with no previously recorded tracks, they discovered perfectly preserved fossilized trails—a "world-class track site," the team's paleontologist, Barry Albright, calls it.

The prints, likely made by reptiles that lived in the Permian period, before dinosaurs dominated the Earth, ranged from iguana size to komodo dragon size. "I've known this place for years," says Scott, "but the discovery transforms these familiar sandstone cliffs into a fossil landscape, a window on a desert ecosystem that existed 265 million years ago."

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NATIONAL
GEOGRAPHIC

THE MALL & WASHINGTON, D.C. (PAGE 60)

- **National Geographic Traveler Washington, D.C.** Plan your visit to the nation's capital with help from this guidebook. Includes details on hotels and restaurants, suggested excursions, and comprehensive information on D.C.'s historic monuments and museums (\$22.95).
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- **Washington D.C. Online** Follow links on nationalgeographic.com/destinations/Washington_D_C to suggested city walking and driving tours and information on nearby attractions.

Who Knew?

NATURAL HISTORY

Moose Proof

It's all about evidence

Persuasive though he could be with his pen, Thomas Jefferson knew that sometimes the only way to win an argument was to present the kind of hard evidence that would wipe the smirk off his opponent's face. That's why, in 1786, while serving as American minister to France, Jefferson desperately needed someone to send him a moose. The recipient of the moose was to be the leading French naturalist, Georges-Louis Leclerc, Comte de Buffon.

Buffon had argued that animals in the Americas were smaller than their counterparts in the Old World. The puma, he pointed out, is "much smaller, weaker, and more cowardly than the real lion." The New World had no elephants, no rhinos, no hippos, and instead of a camel it had this rather pathetic creature called the llama. He carried the same allegation into the human realm: Native American men, claimed Buffon, were less virile than European men. They had no ardor for their females, he said.

Buffon went so far as to say that domesticated Old World

animals carried to the Americas would degenerate. Dogs would cease to bark.

The cause, the comte claimed, was humidity. Organisms that thrived in the Old World were reduced in the New, prevented from thriving in sunlight by "moist and poisonous vapors" in the air.

Buffon's claim was supported by an abbé named Guillaume-Thomas-François de Raynal, who sniffed that America had yet to produce "one able mathematician, one man of genius in a single art or a single science."

Jefferson resisted the temptation to say, What about me? Instead he spent years waging a one-man rhetorical war to defend his continent (and his society) against the French aspersions. Jefferson's *Notes on the State of Virginia* listed the sizes and weights of various animals in the New World. In the category of men of genius, he nominated George Washington, Benjamin Franklin, and David Rittenhouse. The abbé, he noted in a letter, was "a mere shrimp."

But Jefferson needed more evidence. He needed a jumbo American animal. So he arranged for a Revolutionary War general he knew to obtain a moose in New England and

ship its parts across the Atlantic.

Unfortunately for Jefferson, the Moose Proof was a bit inelegant. The seven-foot animal was not as titanic as he'd hoped. The skin had decayed, the hair was falling out, and the antlers had come from another animal entirely.

Buffon died without recanting his claims. But the dogs that came to America continued to bark, and over time the degeneracy hypothesis degenerated, unable to compete with the scientific facts. Theories that aren't true have a tendency to go extinct. In science you can't ignore the 800-pound moose in the room.

—Joel Achenbach

WASHINGTON FIELD STAFF WRITER

How to Stuff a Moose

If Jefferson's mail-order moose had made it to a museum, the final specimen might not have looked much like the original. Early taxidermists were moonlighting upholsterers who padded animal skins—mainly for hunters and natural history buffs—with cotton or rags (hence the term "stuffed animal"). Today's taxidermists, familiar with minute details of animal behavior and anatomy, can produce lifelike mounts by gluing and sewing preserved skins over skeletal frames made from the original animal or mannequins made from casts. Replicas of soft tissues like eyes, lips, and tongues add the final realistic touch.

—Heidi Schultz

WEBSITE EXCLUSIVE For more about Thomas Jefferson, and for links to Joel Achenbach's work, go to Resources at nationalgeographic.com/magazine/0406.

FIELD ILLUSTRATION
BY CARY WOLFE
AND SARAH WEN HORN

TO:
GEORGE
FROM:
TOM



Reaching for Power

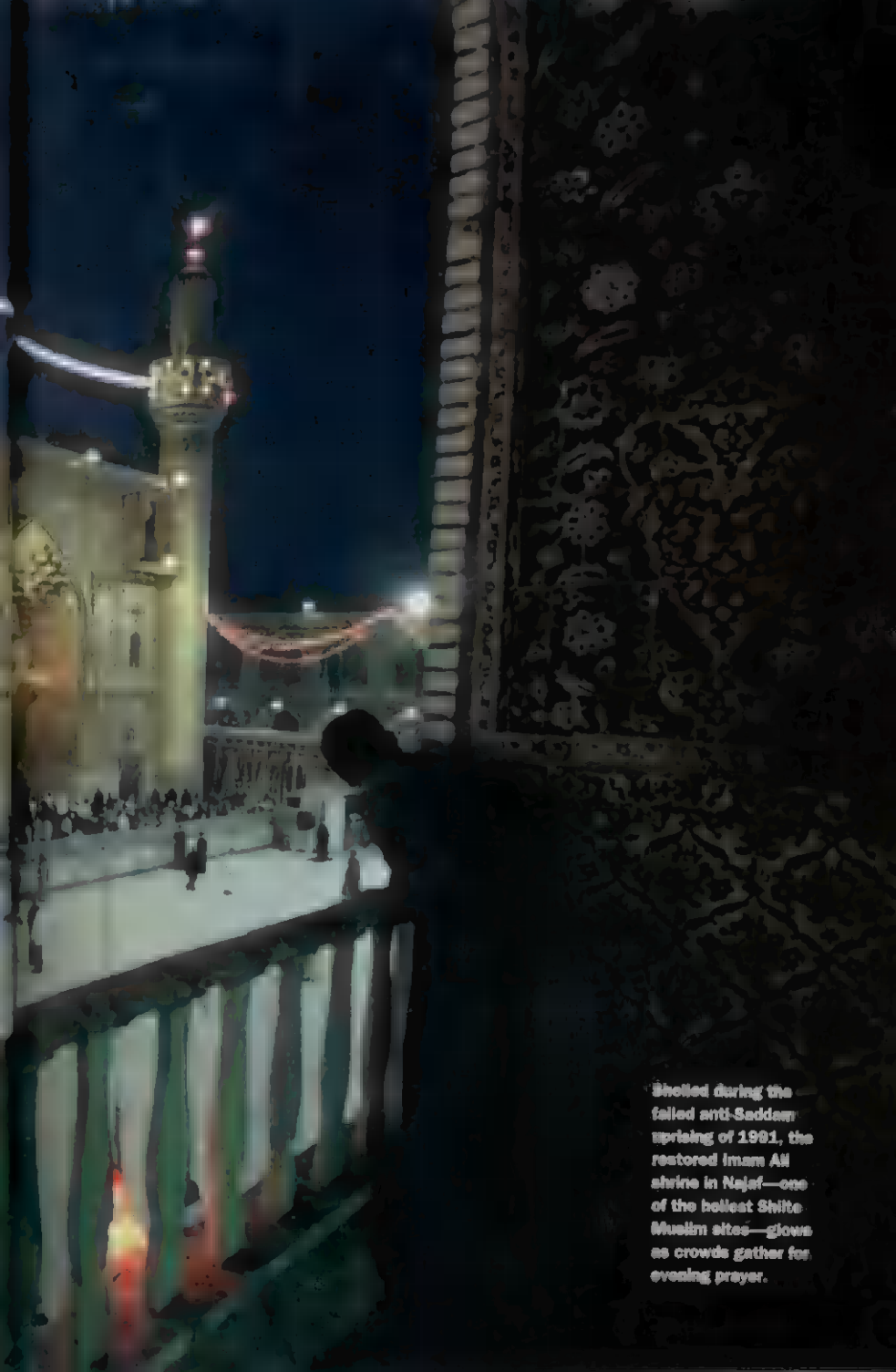
During Saddam Hussein's rule, the SHIITES OF IRAQ
to rule the country. Having been victim



Free for the first time in decades to worship openly, Shiite Muslim pilgrims in Karbala crawl into the shrine of Imam Husayn, whose seventh-century martyrdom still inspires believers.

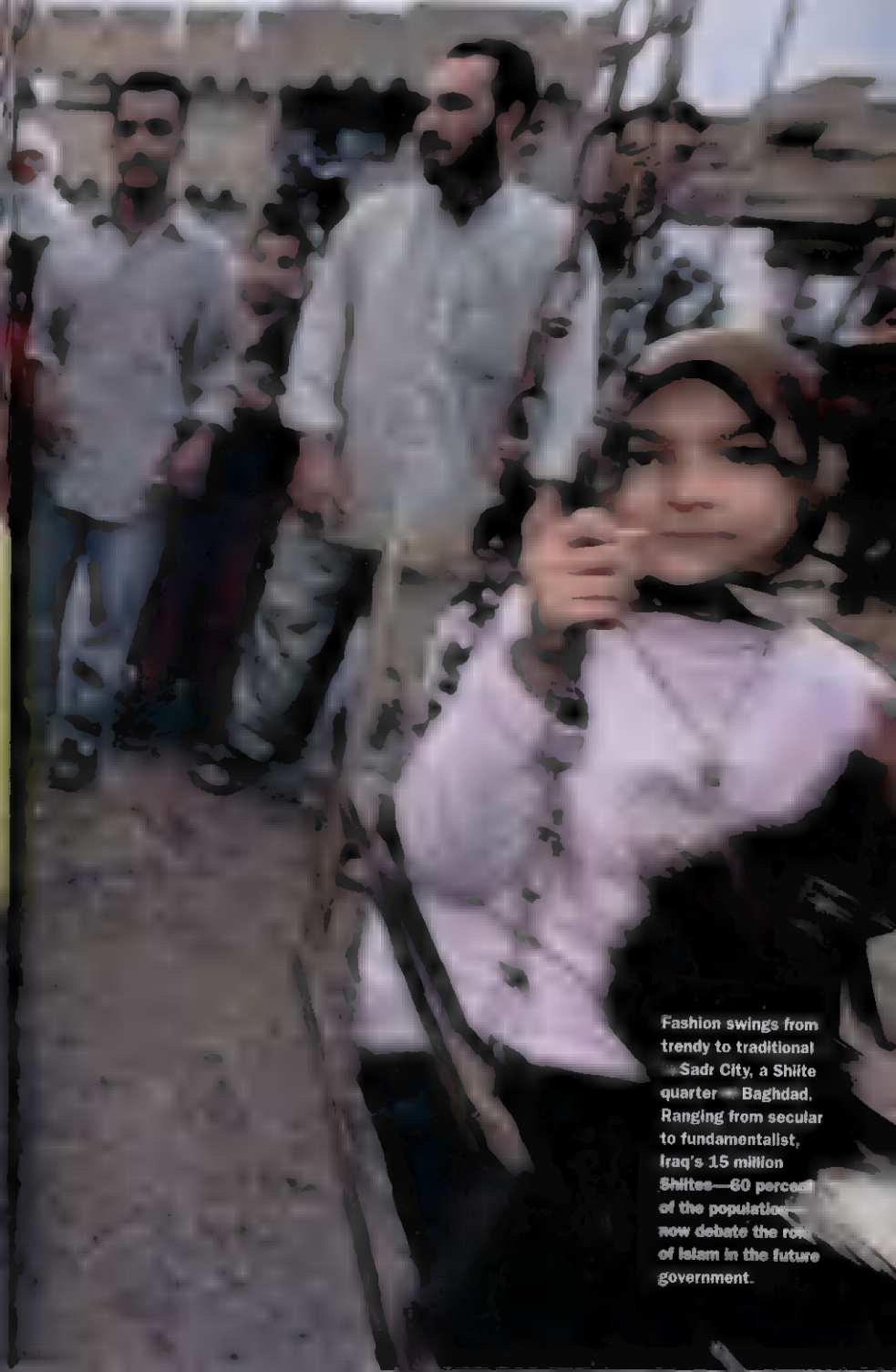
Q were violently repressed. Now they're poised
as for so long, what kind of leaders will they be?





Shot during the failed anti-Saddam uprising of 1991, the restored Imam Ali shrine in Najaf—one of the holiest Shiite Muslim sites—glows as crowds gather for evening prayer.





Fashion swings from trendy to traditional in Sadr City, a Shiite quarter in Baghdad. Ranging from secular to fundamentalist, Iraq's 15 million Shiites—60 percent of the population—now debate the role of Islam in the future government.



The claustrophobic room on Ach-Chwader Street was lit by a single oil lamp. A thin piece of cardboard covered the windows, a futile defense against bombs. Saddam Hussein's regime had just fallen, the war was supposedly over, but there was still

fear in this slum in Baghdad. Word went around the neighborhood that I was taking notes about the disappeared, and the room became full of people who had not spoken out for years. One by one, they shuffled in. All were neighbors. All lived in grim houses made of rough mud and brick, without electricity or running water. All had faces creased with grief, the grief of losing a loved one during Saddam's reign. And all still clung to a distant hope that now that he was gone from power, they might find their son, their father, their sister, their brother.

From the street came the sound of rapid machine-gun fire, from the remaining fedayeen, Saddam's loyal forces. With each round, a woman named Badwiya, whose brother, Ghanim Iraabi, disappeared near the southern city of Basra two decades ago, flinched.

"We're safe here, but outside . . ." she said, waving toward the window. She drifted off. Outside, in the hospitals and the mosques, the followers and militias of local clerics were frantically trying to restore order amid the looters and rioting crowds. "It's madness out there," she said.

The small house belonged to the family of Hilu Issa, a soft-spoken communications student who was 25 years old when he disappeared in June 1980. His family are Shiites, a sect of Muslims who despite being the majority in Iraq were brutalized during Saddam's regime.

One by one, I sat with the Issas' neighbors and relatives to hear their stories, all predictably terrible: The uncle who delivered fiery speeches at the local mosque and disappeared one day without a trace. A whole family of brothers who vanished. A young son of whom his mother wistfully said, "I just wish I could feel him, touch him, see him."

This was just one street, in one neighborhood, in one city in Iraq. It is difficult to imagine how the Shiites of Iraq will get past this trauma, will learn to live without a spirit of vengeance. But they are trying to move forward, to come out of the darkness that was the Saddam era. In today's Iraq this could be called the time of the Shiites. Since the fall of Saddam on April 9th last year and his capture on December 13th, the Shiites have used their newfound freedom to rename bridges, streets, and squares after revered Shiite leaders. They are practicing rituals and displaying iconography forbidden during Saddam's days. But the real changes lie ahead.

On June 30th Iraq's provisional government is set to assume full sovereign powers for ruling the new country. While the details of how that government will be formed are still being sorted out, this much is clear: With Shiites representing some 60 percent of the country's population,

Overwhelmed by his visit to Najaf, a pilgrim from Iran weeps outside the tomb of Imam Ali, spiritual founder of the Shiite branch of Islam. Saddam's government, made up mostly of the Sunni minority, had restricted Shiite pilgrims from abroad. Now worshippers pour across Iraq's borders to visit their faith's most sacred places.



In a landscape where once illegal satellite dishes sprout from rooftops, pilgrims converge on the shrine of Abbas ■ Karbala. Since the war, Iraq's shrine cities (map) have been scenes of celebration and violence. In March around 130 Shiites were killed in explosions in Karbala.

a Shiite-dominated government seems inevitable. After decades of oppression, first by the British-imposed Sunni monarchy, and then by Saddam's secular Baath regime, the Shiites have emerged as key players in shaping a new Iraq.

What is less clear is how they will govern a country that is unified in name only. Over its eight decades as a modern state, Iraq has never forged a unifying national identity. Its population is divided into a variety of overlapping ethnic and religious groups all vying for power, with Kurds predominantly living in the north, Sunnis in the center of the country, and Shiites concentrated near the shrine cities and in the south. As the United States prepares to end its occupation at the end of this month, some of the mullahs who guard the shrines speak softly of civil war between Shiites and Sunnis or worry that Iraq will fall the way of neighboring Iran, a country that is nearly 90 percent Shiite and is ruled by Islamic clerics. These are also concerns for the Bush Administration and for some of Iraq's neighbors, like Jordan, Turkey, and Saudi Arabia, whose populations are mostly Sunni, as are 88 percent of the planet's 1.3 billion Muslims.

"The Shiites had it so bad for so many years that we deserve this power," says Saad Jabr, a prominent Shiite living in exile whose father, Saleh, was the prime minister of Iraq from 1947-48. "And we won't relinquish it because we don't want the persecution to ever happen again." As the world watches, the Shiites must figure out what they want—now that they finally have a say in their country's future. But how ready are they to forgive the past?

THE SHIITES MIGHT NEVER have become the majority in Iraq if not for the building of a canal. Until the beginning of the 19th century, Shiism was practiced mostly in the shrine cities of Najaf and Karbala,

Shiites might never have become the majority in Iraq if not for the building of a canal. When water was brought from the Euphrates to the arid south in the 19th century, Arab tribes settled down and converted to Shiite Islam.

many of whose residents were Persians from the region that is now Iran. But when the Hindiyah canal brought water from the Euphrates River to the arid south in the 19th century, Arab tribes gravitated to the area and settled down to grow grain, rice, and dates. Living so close to Shiism's holy cities, these Arabs converted from Sunni to Shiite Islam rapidly, explains Yitzhak Nakash, author of *The Shi'is of Iraq*. Later, when modern Iraq was formed, Shiites migrated to the center of power in Baghdad, and political tensions between the Sunnis and Shiites sharpened.

Every schoolchild in Iraq can tell you the story of the schism between Shiites and Sunnis. "It is written in our souls," a young Shiite student told me. "It is a clear part of our identity." And it is key to understanding the Shiites' profound sense of persecution and grievance.

The split arose from a dispute over who should succeed the Prophet Muhammad after his death in A.D. 632. Some followers believed his successor should be chosen by tribal consensus, and they named one of Muhammad's inner circle as the first caliph, or spiritual leader. But others thought the successor should come directly from the Prophet's family, namely his cousin and son-in-law Ali. Over the next 24 years Ali attracted a group of disciples and finally became the fourth caliph. But his leadership was challenged by tribal Arabs who resented his following among the Persians. He was assassinated just five years later. Ali's grief-stricken followers—who would become the Shiites—granted his dying wish by tying his body to a camel and burying him wherever it stopped, which happened to be Najaf. A mosque and a shrine were later erected over his tomb, and the site became one of the most holy places in Shiite Islam.

After Ali's death, the struggle for succession carried on, and his supporters called upon his second son, Husayn, to rise up against the seventh caliph, Yazid. Husayn began a trek through the desert with his family and a small army of defenders.

They got as far as Karbala, when thousands of Yazid loyalists ambushed them. They managed to hold out for eight days before being massacred. Husayn allegedly died with a sword in one hand, a Koran in the other, saying, "Death with dignity is better than a life of humiliation."

Fourteen centuries later, in the



Some of the mullahs who guard the shrines speak softly of civil war between Shiites and Sunnis or worry that Iraq will fall the way of Iran, a country that is 90 percent Shiite and is ruled by Islamic clerics.

last days before the U.S.-led invasion of Iraq, I asked Thaar, my Baathist minder, if I could visit Karbala, the site of Husayn's murder, during the feast of Id al-Adha. He grudgingly agreed, provided I did not ask people about politics and that I wear an *abaya*, a head-to-toe black garment. We drove 55 miles south of Baghdad along dirt roads lined with swaying date palm trees that Thaar said symbolized the pride of the Iraqi people.

On our way into town, we took a wrong turn and ended up near one of the vast cemeteries that surround Karbala. I had read about the city's flourishing corpse trade, but still I was startled: The wide expanse of grave after grave, tens of thousands of them, stretched on for miles. At the beginning of the 19th century both Najaf and Karbala prospered from the desire of devout Shiites to be buried near Ali and Husayn. Their bodies, dried and wrapped in carpets, arrived here from Persia and Central Asia, the camel caravans taking up to a year to deliver them. Now, among those buried here were the victims of Saddam's regime.

On this warm and cloudless winter day, dozens of families were picnicking in front of the graves, sitting on blankets and praying for the dead. As they peeled oranges and poured out cups of sugared mint tea, tears rolled down their cheeks. Some carried jugs to water the earth, planting bright-colored flowers. In between the tombstones, beggars wandered, hands outstretched for money, which the mourners dutifully gave.

Breaking away from Thaar, I sat with one family, a son and a mother, on the hard winter earth and tried to penetrate their wall of fear and grief. "As Shiites, it is a great comfort to know he is buried next to Husayn," said the mother, speaking of her dead husband. Every time the son tried to talk about what it was like being a Shiite, Thaar appeared, hovering and frowning. The young man would fall mute. All around him were the graves of people who died for saying too much.

When I whispered a question about religious persecution, the mother shot me a look of pure horror. "War and embargo are public sadness," she said, changing the subject rapidly, her eyes flicking nervously toward Thaar. "But every death is a private sadness."

Thaar and I drove on to the center of Karbala, which is dominated by the shrines of Husayn and Abbas, their gold domes glittering in the wan sunlight. Historically Persian in its architecture and bazaars, Karbala was pounded with artillery and tank fire in 1991 to crush the Shiites, who had been encouraged by the U.S. to rebel against Saddam in the aftermath of the Persian Gulf war. The uprising was short, but 14 out of Iraq's 18 provinces rose up against the regime, some holding out for weeks before Saddam's troops prevailed. The punishments doled out afterward were bloody and profound. Tens of thousands were slaughtered. The shrines were damaged, the bazaars around them bulldozed, and although Saddam rebuilt the city, it had not regained its vibrancy as a center of religious learning.

Around the shrine we followed winding alleys where vendors sold strings of dates and dried-up oranges and shops displayed prayer rugs.

In teahouses men sat cross-legged, gossiping, with few women among them. We wandered down the alleys, and Thaar explained the feast, in which a young sheep is slaughtered to celebrate Allah's last-minute command to Abraham to sacrifice an animal instead of his son.

We bought mint tea and found an elderly man, Haji Abbas, preparing to slaughter his sheep with a handmade knife. For sacrificing this male sheep with no deformities, the man believed he would get three wishes from Allah. "The Koran says that God wanted to test Abraham's faith," he said. "In the same way we Shiites are tested, day after day, in this life." Then he pulled back the throat and sliced slowly, catching the fresh blood in a bucket. The sheep twitched and jerked and took a long time to die. The crowd watched silently.

Over the years the number of pilgrims entering Karbala had diminished, hastened by Saddam's restrictions on public religious gatherings. Still, at the shrine of Husayn we saw thousands of Shiites, many having made the pilgrimage on foot, by bus, by minivan. People were selling small pieces of earth from Karbala because it was where Husayn's blood was spilled. Others tied around their arm pieces of green cloth—the color on the Islamic flag that represents the descendants of the Prophet Muhammad. An elderly woman, a pilgrim from Basra, tied a cloth around my forearm even though Thaar explained I was not a Muslim. She shrugged. Thaar smiled and said, "Now you can make a wish."

Inside the eight gates of the shrine, a sea of people squatted and kneeled. There was no room to move, and once inside the courtyard, it took all my strength to make my way back to the gates. Dead bodies were being carried by chanting men. A family of eight, the youngest an infant, the eldest 70 years old, sat near the shrine, the adults persistently mouthing prayers.

"It took days and days to get here," said Jamila Bishrian, a southern Iraqi pilgrim wearing a colorful abaya who had pale green tattoos etched on her face—a marking common among tribal Shiite women. She said her family had slept in the courtyard near the mosque for three days in the open desert air. But Jamila said it was worth it. She did not mind the crowds or the confusion. Being close to the shrines where religious leaders were buried meant that she had a better chance at getting to paradise.

EVER SINCE THE IRANIAN REVOLUTION in 1979, governments inside and outside the Arab world have feared Shiite fundamentalism. In Iran the ruling ayatollahs and the Council of Guardians—who ensure that strict Islamic law is adhered to—freely mix religion with politics. Their fiery speeches at Friday prayers in the Tehran mosques ring out with anti-American and anti-Israeli

(Continued on page 20)



A watchman at a Najaf market has thieves—and more—to worry about ■ the chaos ■ post-Saddam Iraq. Factional struggles have provoked armed clashes between supporters of rival clerics in the holy city.



Displaying an image of Imam Ali, son-in-law and cousin — the Prophet Muhammad, brought censure during Saddam's regime. Now a vendor in Najaf, sells Ali posters without fear of reprisal.





Today the most influential Shiites in Iraq are religious leaders—and they are making their voices heard. Apart from Ayatollah al-Sistani, a handful of other clerics, some with their own militias, are rushing to fill Iraq's power vacuum.





A Strict Vision of the Future

Down, down with America; down, down with Israel." His words still echoing after Friday prayers at a mosque in Kufah, Muqtada al-Sadr (top left, at center) huddles with supporters. Making good on his threats, the young cleric, who favors an Islamic theocracy,

called on followers in early April ■ violently oppose occupation. After Saddam's fall, al-Sadr built support ■ poor Shiite neighborhoods by providing food, medical care, and security. In an effort to impose sharia, the Muslim legal code, his militias enforce bans on pop music, alcohol, and por-

nography; smoking is tolerated. At an independent court set up by al-Sadr in Najaf, a cleric takes a puff (left) after finding incriminating images on a CD. The penalty for one merchant: ten lashes with a rubber hose (above). Most senior Shiite clerics frown on al-Sadr's heavy-handed approach.

**A tea vendor
■ Najaf stops to
refresh merchants
who—for the first
time in years—can
taste prosperity.
The end of trade
sanctions and the
return of religious
tourists and stu-
dents have packed
hotels and filled
market stalls as
Najaf regains its
role as a center
of Shiite learning.**

views. Indeed, ■ was the fear that Shiites might create a similar fundamentalist Islamic state in Iraq that largely kept the first President Bush from supporting the uprising following the gulf war.

But in Iraq, most Shiite clerics have long advocated a separation between religion and politics. Many Shiites are secular, some are educated and middle class, but most are desperately poor. The religious people I met were not fanatic, but simply beaten down. "Don't think all Shiites are radical fundamentalists," says Fadil al Milani, the dean of International Colleges of Islamic Studies in London and a leading cleric. "Most just want to see justice done."

One of the Shiite families I became closest to before the war, living in the Adhamiya neighborhood of Baghdad, was as secular as a typical middle-class family in New York or Paris. The father was ■ tweedy professor who spoke English with a British twang. His wife had given up a professional job to raise their three daughters. When I came to dinner, they prepared a fat roasted chicken, cauliflower in cheese sauce, and a tossed green salad. It felt as if I were at a traditional Sunday lunch in England, except that when they drove me home, the mother and her eldest daughter carefully donned *hijab*, or head scarves.

In the months before the war it was unusual for any Iraqis to invite foreigners into their homes, let alone Iraqi Shiites, and I often wondered why this family was so friendly to me. Our conversations carefully skirted the sensitive issues I wanted to know about—I didn't want to take advantage of their hospitality by landing them with a visit by Saddam's secret police. But I did talk to the eldest daughter, who was 19, about what it was like to date as a Shiite woman in Iraq. "We go out in groups," she said.

This family is a part of Shiite society largely invisible to the world. It's true that most Shiites are descendants of agrarian peasants in the south. But as the shrine cities declined in the 1930s and '40s, Shiites started to



"It took days and days to get here," said Jamila Bishrian, a southern Iraqi pilgrim. She did not mind the crowds or the confusion. Being close to the shrines meant she had a better chance at getting to paradise.

migrate to Baghdad, adopting urban clothing, enrolling in schools, and losing some of their religious identity. Despite decades of discrimination, many Shiites became successful as intellectuals and small-scale merchants.

Between 1973 and 1979, as oil income exploded from 13.3 to 41.6 billion in today's dollars, Iraq was transformed from an agrarian to an industrial economy, and everyone, even the Shiites, benefited. Then came the Iran-Iraq war, followed by the gulf war, and the UN sanctions. "Until the '90s, Shiites were the backbone of the middle class," says Yitzhak Nakash. "Twelve years of sanctions made the middle class destitute and passive, and hindered their ability to emerge as a group that advocates political change." Many of Iraq's middle class left to live in exile, and those that remained tried to become invisible, living in half-vacant houses, having sold possessions to pay for essentials.

But the truly impoverished lived in Saddam City (since renamed Sadr City), a slum in Baghdad that is home to nearly two million Shiites. It was a world away from Baghdad's middle-class neighborhoods, where boutiques sold Armani suits and Zanussi washing machines. My minder, Thaar, was intent on showing me a favorable view of the slum, but there was no denying the smell of raw sewage that ran through the marketplace, where a few scrawny chickens were being sold. The vegetables on display were old and withered. The shops offered only a few tins of beans and some packets of rice.

At Saddam City's main hospital, I was mobbed by tearful parents holding sick children. In whispers, they told me Shiites weren't given proper medical care. One mother held out a boy with thalassemia, a rare blood disorder that had enlarged his head and turned his skin yellow. "It all goes to them," she managed to say before Thaar yanked me back into the car.

It was a depressing visit, but I left with one very strong impression: That once Saddam was gone, this heaving mass of people who had been ground down for so long would clearly rise up and take control.

THE SHIITES HAVE LONG DREAMED of rising to power in Iraq, a dream that was first squelched when, in alliance with the Sunnis, they failed in their rebellion against the British colonial power in 1920—a time of occupation that many older Iraqis still look back on with bitterness. To the Shiites' great disappointment, the British then installed a foreign Sunni monarch, the Hashemite King Faisal, to lead the modern state of Iraq, paving the way for decades of Sunni dominance.

Both the monarchy and later the Baath Party, which came to power in 1968, emphasized the idea of Arab unity over a distinct Iraqi identity. Though made up primarily of Sunni Arabs, the Baathists were staunchly secular. They distrusted the "backward" and "fanatic" Shiites, depicting them as Arab-hating Persians whose loyalties lay with Iran. Throughout the '70s the Baathists stepped up the oppression of Shiites, which fueled the rise of al-Dawa ("the Call"), a political party dedicated to the



establishment of an Islamic state in Iraq. Al-Dawa's resistance only increased the persecution. The Baathists executed five clerics without trial in 1974. Three years later, after Shiite demonstrations in the shrine cities, eight more clerics were executed and 15 were sentenced to life imprisonment.

A father prepares to cut his son's head in a ritual meant to identify with Husayn's suffering when he was killed in A.D. 680—and to express the Shiites' collective guilt at not having come to his aid.

even worse after the Iranian revolution. Emboldened by the creation of an Islamic state next door, tens of thousands of religious Shiites joined the resistance party and began attacking Baath offices. As al-Dawa became more militant, membership in the party became illegal, and anyone who assisted a member could be imprisoned or executed.

Hilu Issa was a gentle young man, not unusual, not really special, his father, Haj, told me. Like many Shiites, Hilu did not join the Baath Party and refused to go into the army. "He was not a military man," his mother, Haja, said quietly. He was religious, she recalls, but not overzealous.

But Hilu was a member of the al-Dawa Party. He was taken away one summer night in the months before the Iran-Iraq war in 1980, a time a neighbor remembers as "a Shiite witch hunt." During the bloody eight-year war, Shiites were hunted down and forced to prove they were not Persians, and thousands disappeared or were expelled from the country.

At first Haja's instinct was to follow her son to Amarah, a city 200 miles from Baghdad, where the family was told he was being held. Then her husband got a warning from a neighbor who had links with the secret police. "They told me to stop asking questions. I thought if I continued,

THE SHIITES' LONG ROAD TO POWER

A.D. 632-680

The Shiite-Sunni Split

When the Prophet Muhammad died in 632, some (who would later become known as Shiites) believed his son-in-law and cousin Ali should be the first caliph, but he was passed over. Ali eventually became the fourth caliph, but was assassinated in 661. Two decades later, in 680, Ali's son Husayn was killed in battle in Karbala when he challenged the seventh caliph, cementing the split between the sects.

1920-1932

Revolt Against the British

With the fall of the Ottoman Empire and the end of WWI, Britain and France carved up the Middle East. Control of Iraq went to Britain in 1920, and Shiites and Sunnis joined together briefly in rebellion. Britain crushed the revolt and installed a non-Iraqi, Faisal, as king, setting up Sunni governments. Viewing Shiite clerics as a threat, Faisal sought to lessen their power. Iraq gained independence in 1932 but stayed a monarchy.

1933-1957

Demands for Equality

Denied adequate representation in government and the civil service, Shiites demanded reforms. Demonstrations broke out in Shiite areas and led to a failed revolt in 1935. Although more Shiites became educated and the monarchy gradually increased the number of Shiites in government positions, the Sunnis remained firmly in control. Hoping to gain greater political clout, many Shiites joined the underground Iraqi Communist Party.

1958-1978

Baath Rise to Power

The monarchy was overthrown by a military coup in 1958, and unrest ensued. The Baath Party took over the government in a 1968 coup, and Saddam Hussein rose in power. To thwart the appeal of communism among Shiites, a group of Shiite leaders formed a political party, al-Dawa, to oppose the secular state. As the Baath repressed religious practices and executed several Shiite clerics, both secular and religious Shiites were drawn to Islamic ideology.

The Shiites have long dreamed of rising to power in Iraq, a dream that was first squelched when they failed in their rebellion against the British in 1920—a time of occupation that many still look back on with bitterness.

he would get killed, I would get killed, and that would be it," he says. "So I stopped asking questions."

But the Issas did not stop thinking of their gentle son. His mother said sometimes she ached just to hug him or to hear his voice. She says the rest of the family suffered, her three daughters were ostracized and never married. People were afraid to be associated with the family. "For us, we were dead while we were still alive," she said.

Now, with Saddam in custody, both his parents want to look for Hilu. They believe, as all parents must, that he is still alive. "He's my only son. You know life seems without purpose without him. For 24 years I've had no word, but I never forget him, day or night," Haj Issa says. "Now we will begin to find him."

THE QUESTION OF THE MOMENT is whether Iraq's Shiites can put aside the grievances that have shaped their identity and carve out a new self-image as a people. That will not be easy. "Saddam's government made sure there weren't any secular Shiite organizations. That's why the Islamic religious organizations became so strong," says Yitzhak Nakash. "It was the only way to express a Shiite identity."

Today the most influential Shiites within Iraq are religious leaders—and they are making their voices heard. In recent months the Grand Ayatollah Ali al-Sistani—the most revered Shiite cleric in Iraq—has become a force to be reckoned with. While not seeking a place in the new government himself, he has been highly influential in working out the details of how power will be transferred from the U.S. to the Iraqis, and how a new constitution will be written.

1979-1989

An Islamic State Next Door

The same year Saddam took over as president of Iraq, Iranians overthrew the shah and installed a Shiite theocracy. Fearing the emboldened al-Dawa's growing power, Saddam launched a campaign to abolish the party and in 1980 had its leader, Muhammad Baqir al-Sadr, executed. Many Shiites were deported or fled to Iran. Yet when Saddam invaded Iran in 1980, Iraqi Shiites fought against Iranian Shiites in the eight-year Iran-Iraq war.

1990-2002

The Persian Gulf War

Iraq invaded Kuwait in 1990, prompting U.S.-led forces to push Iraq back inside its borders. George H. W. Bush encouraged the Shiites and Kurds to revolt against Saddam but withheld military support. The uprising was violently put down by Saddam's forces. Tens of thousands of Shiites were killed and many more went into exile. The United Nations passed resolutions demanding that Iraq eliminate its weapons of mass destruction.

2003

U.S. Invasion ■ Iraq

After negotiations with the UN broke down, U.S.-led forces entered Iraq in March 2003 and overthrew Saddam's regime. The U.S. created an interim Iraqi Governing Council (IGC), made up of 25 representatives, including 13 Shiites. Two leaders of major Shiite families returned from exile and were assassinated. U.S. occupation forces faced continued opposition. The former leader was captured on December 13, 2003.

2004

Shiites Poised for Power

The IGC signed an interim constitution despite the objections of Grand Ayatollah Ali al-Sistani (below), who wanted a charter approved by an elected national assembly. The U.S. occupation is set to end June 30.



AP/GETTY IMAGES

As Iraqi Shiites struggle to forge this new future, they share a common distrust of Americans, which traces back to when the U.S. failed to support the 1991 uprising against Saddam following the Gulf war.

Apart from al-Sistani, a handful of other clerics, some with their own militias, are rushing to fill Iraq's power vacuum. A few have been working with the Americans, like Abdulaziz al-Hakim, a member of the Iraqi Governing Council—the U.S.-appointed administrative body made up of 25 Iraqis. Al-Hakim and his brother, who was assassinated last August outside the Ali shrine in Najaf, have close ties to Iran, where they sought exile during the decades of heavy persecution by Saddam's regime.

There are also younger, more extreme leaders emerging, such as Muqtada al-Sadr, the cleric who called upon his followers in early April to "terrorize your enemy," leading to violence against occupation forces. "Muqtada is popular, but you have to look at Iraqi Shiites not as one large group, but many," says Saad Jabr, who heads the Free Iraqi Council, based in London. He believes that most Iraqi Shiites are too moderate to take up with al-Sadr. "Iraqis don't want to be like Iran. They are not fanatics."

Recent history suggests that Iraqi Shiites' sense of national identity is too strong for them to go the way of Iran. While it's true that both countries are mostly Shiite, Iranians are predominantly Persian while most Iraqi Shiites are Arab. In fact, Iraqi Shiites fought against fellow Shiites in Iran during the Iran-Iraq war. Unlike the Kurds, who have desired a separate state, the Shiites have never wanted to pull away from Iraq. Many point out that their uprising in 1991 was directed at Saddam, not the Iraqi state itself.

"It is an absolute nonstarter that we will fall under Iran's influence," insists Saad Jabr. "In the old days, the tribes in the south would not give their daughters to Iranians—it was considered shameful. There is a great source of pride in being Iraqi Shiites."

A sense of shared Arab heritage explains why many also discount the prospect of a civil war between Sunnis and Shiites. Ahmad Chalabi, the American-educated mathematician who was among those who argued for the U.S. invasion of Iraq, says a civil war simply will not happen. "Sunnis and Shiites have never fought against each other. The violence was always perpetrated by Saddam," he says from the grand Baghdad residence where his family lived until the monarchy fell in 1958. Chalabi, a secular Shiite and the president of Iraqi National Congress, returned to Baghdad as a member of the Iraqi Governing Council.

"The future for Shiites is bright," Chalabi says, "because it is the end of discrimination, the end of exclusion. There will be full participation in the government. That is what Shiites expect and what they will get."

As Iraq's Shiites struggle to forge this new future, they share a common distrust of Americans, which traces back to when the U.S. failed to support the 1991 uprising against Saddam, and Shiites felt severely let down. More than a decade later most Shiites I spoke to constantly reminded me of this betrayal by the U.S. Old wounds are not easily healed.

"I see a potential parallel today with what happened with the British in 1920," says Yitzhak Nakash, the expert on Iraq's Shiites at Brandeis



University. "Iraq is being re-created today, and if Shiites feel they are being robbed of power, they might again rebel against their occupiers."

MY RELATIONSHIP WITH THE FAMILY from the Adhamiya neighborhood ended with a strange twist. Recently I heard that the father had been a senior Baathist and an active member of Saddam's secret police. I consulted a private security and intelligence company whose agent in Baghdad did some background checking and confirmed, albeit through unnamed sources, that the man I knew as a tweedy professor indeed had worked for Saddam's secret police: "He was up to his neck in supporting the regime."

It was upsetting to think that the home where I had often taken refuge may have been run by an informant—who was probably taking notes about me. No doubt he felt he had to protect his family the only way he knew how. But anyone affiliated with Saddam's secret police would be complicit in the suffering of many innocent people.

The suffering—and the violence—is not likely to end soon. Since May 2003, when George W. Bush announced the end of combat in Iraq, the holy cities have experienced an economic boom as pilgrims from both Iran and Iraq crowd into the cities. But what visitors find now is simply a different danger from that of the Saddam days. Several prominent Shiite clerics have returned from exile to the shrine cities and been killed—hacked to death or blown up with car bombs. Some of these killings have been blamed on an internal power struggle among followers of different Shiite clerics. But more recently U.S. officials have attributed the violence to outside terrorist organizations seeking to spur conflict between the Sunnis and Shiites. In early March of this year, explosions killed an estimated 130 Shiites in Karbala as worshippers observed Ashura, the day commemorating Husayn's death. Coordinated with a similar attack

Growing up secular in Baghdad, brothers Mazal and Salam Saad celebrate a score at a Shiite-owned arcade. Patrons also play slot machines, making the place a potential target of militias intent on enforcing Islamic laws against gambling.

"The Shiites had it so bad for so many years that we deserve this power," says Saad Jabr, a prominent Shiite in exile. "And we won't relinquish it because we don't want the persecution to ever happen again."

Shiite teen Noor Abdel Hadi tries on her cousin's hijab at her home ■ Hillah. Whether she eventually wears a veil in public is considered her choice, but Muslim women often cover up to avoid public harassment or defer to a husband's wish for a show of modesty.

in Baghdad, it was the bloodiest day since the end of the war. And U.S. officials anticipate more violence in the coming months.

"The future is dark," says Hussein Ali Kadhim, 39, a mullah working in the shrine of Abbas, "not for Sunni versus Shiite, but for fighting between the Shiite clerics themselves and their supporters." The Shiites, he says, have a long way to go to recover from the years of repression. "We can pray openly, but now the shrines are full of weapons."

But Shiite cleric Fadil al Milani remains optimistic. He thinks the violence will subside and that the Shiites will find their way after years of feeling powerless. "Once everything has settled down," he insists, "then all together, we will head toward a better life."

On the feast of the anniversary of Ali's death, Hamid al-Assadi, a 46-year-old Karbala merchant, stood outside his shop, watching the streets. He was doing a good business selling prayer beads, rugs, and clods of Karbala earth. The streets were full of worshippers—thronging men in black dishdashas, beating themselves with chains to symbolize Ali's suffering. It was the first time Shiites had been free to perform this public ritual for three decades. It is for this, Assadi says, that Shiites must be thankful. "Now we are in paradise," he said. "Before we were in hell."

BACK IN BAGHDAD, IN SADR CITY, the Issa family are no longer looking for their son. They have discovered that Hilu was executed three years after he disappeared and that he was buried in a mass grave with 42 other victims. By mid-January of 2004, human rights organizations said that 270 sites had been reported and 53 confirmed. They estimate at least 300,000 people were "disappeared" in the past two decades, the majority of them Shiites. The Free Prisoners Society, which was set up to help families of victims, believes there are many more. Ibrahim al-Idrisi, a spokesman for the group, estimates the number at five million to seven million.

"The people are so furious, and we try to calm them down, tell them to wait till we have courts to judge the criminals," al-Idrisi says. "But some of the families already know the guy who carried out the execution."

The Issas think they know the man who gave information to the authorities about Hilu. But they just wanted to find his body. Haj Issa went to claim his son's remains, but he could not tell which bones were his. "I feel desperate," he says wearily.

The family is only now beginning to accept that their beloved son, who disappeared when he was 25 years old, will never come home. Haj is bitter about the lack of security under the U.S. occupation. Most of all he wants reassurance—to believe that the Shiites' suffering will not be in vain.

ENTER THE SHIITES' WORLD Experience what it's like to live among the Shiites in a special multimedia Sights ■ Sounds feature narrated by photographer Matt Moyer. Plus: updates and a forum on the direction of the new Iraqi government at nationalgeographic.com/magazine/0406.



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Killings Haunt Iraq

Opening new wounds of grief, an Iraqi sobs with a rib bone in his hand after searching for remains of a family member in mass graves north of Hillah. More than 2,000 bodies have been dug up, most of them young men. Their deaths date to the aftermath of the 1991

gulf war when Saddam ordered troops to eliminate Shiites accused of rebelling against his regime. Human rights and forensic investigators are gathering evidence from graves to be used in the filing of war-crime charges against Saddam and his top officials. Many families able

to identify remains bring their loved ones for an Islamic burial near Imam Ali's tomb at Najaf's Valley of Peace cemetery. At the cemetery morgue, trauma almost becomes routine as a worker washes off (left) while the body of a recent robbery victim is readied for interment.



An Offer She Wouldn't Refuse

G irlish days of playing at home while her mother and sister bake bread will soon end when 14-year-old Noel Abdel Wahid leaves home to marry a cousin—and thus aid her family's efforts to escape poverty. The Wahid family lives in a two-room house without

plumbing in Sadr City, Baghdad's huge Shiite slum. According to the father, who holds down two jobs, the family hasn't been able to afford meat for five years. Because of blackouts, they eat by oil lamp on many nights, under pictures of Shiite martyrs (right). Seeing her family

struggle, Noel told photographer Matt Moyer that she reluctantly accepted her cousin's proposal despite the objections of her mother, Sadia (above right, at left), who herself married at ten. The cousin agreed to pay the Wahids \$400—and that settled it for Noel.



The impoverished live in Sadr City, a slum in Baghdad that is home to nearly two million Shiites. It's a world away from the city's middle-class neighborhoods, where boutiques sell Armani suits.







Daybreak greets a cloaked passerby at the Imam Ali shrine. The space will soon fill with believers ecstatic that the time for Iraqi Shites has finally come. italy.com



THERE'S A PLACE IN
CALIFORNIA WHERE THE
SUN NEVER SHINES:
MONTEREY CANYON

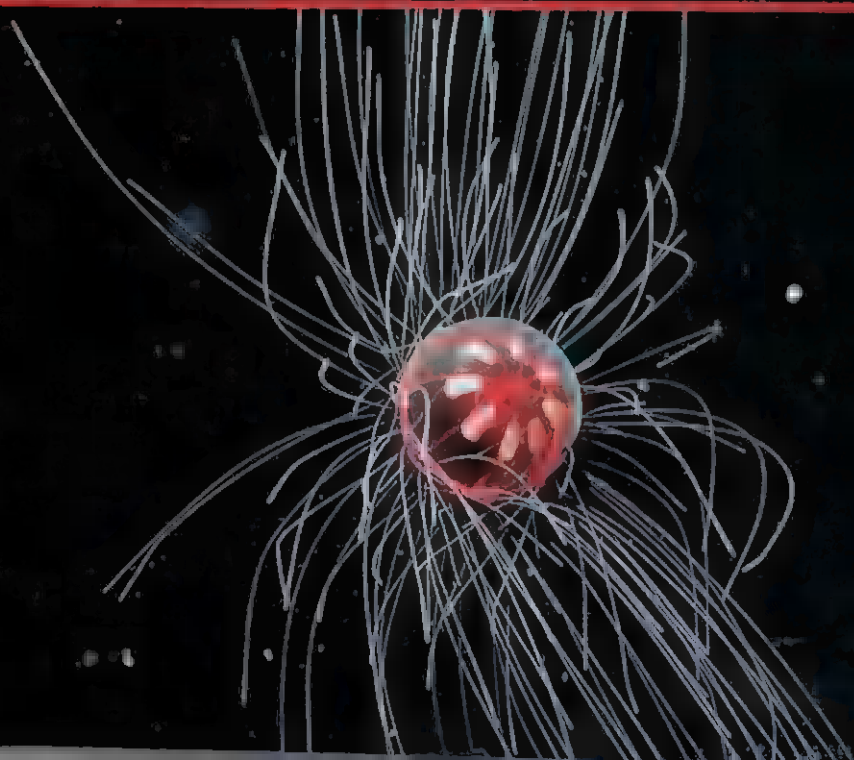
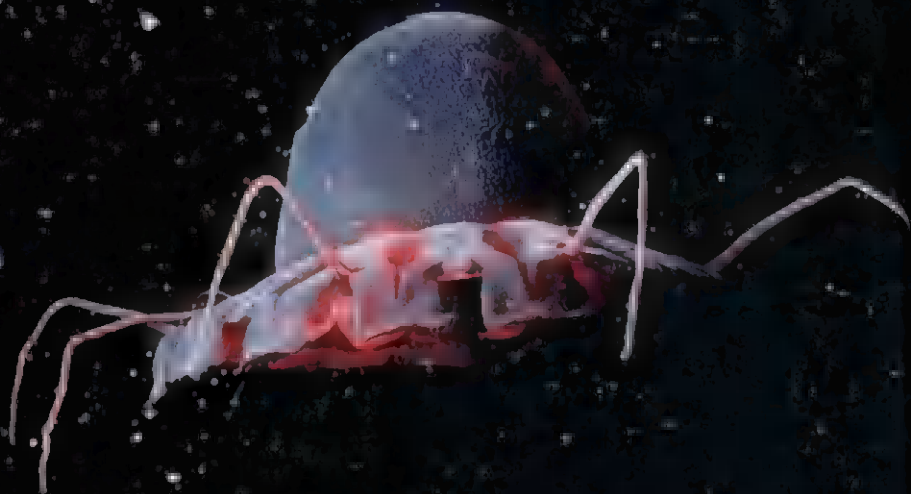
A spiky fanfin anglerfish searches for prey
with its sensitive rays and forehead lure.

CAULOPHYRINE JORDAN 18 INCHES, CARTIVE SPECIMEN, BRUCE ROBISON



Way Down

Deep





Like a spaceship prop from a vintage movie, *Nausithoe rubra* (top left) hovers among the stars—actually flecks of organic matter that many deep-ocean species eat. Other Monterey Canyon jellyfish are just as otherworldly: the hula skirt siphonophore (right)—named for its palpons, which resemble a swaying grass skirt, and *Crossota millsae* (left), trailing tentacles flung wide,

NAUSITHOE RUBRA (1 IN), CAPTIVE SPECIMEN, GEORGE MATSUMOTO, MONTEREY BAY AQUARIUM RESEARCH INSTITUTE (MBARI); *PHYSOPHORA HYDROSTATICA* (8 IN), CAPTIVE SPECIMEN, GUYE WROBEL, MBARI; *CROSSOTA MILLSAE* (1 IN), MBARI.

BY VIRGINIA MORELL

“OK, THERE IT IS—OUR MYSTERY MOLLUSK.”

Bruce Robison leans in toward his color monitor. A ghostly creature resembling a cross between a megaphone and Thing, the *Addams Family* pet hand, floats on the screen. The soft, oval lips of its megaphone roll in and out, while the hand waves up and down, slowly and rhythmically.

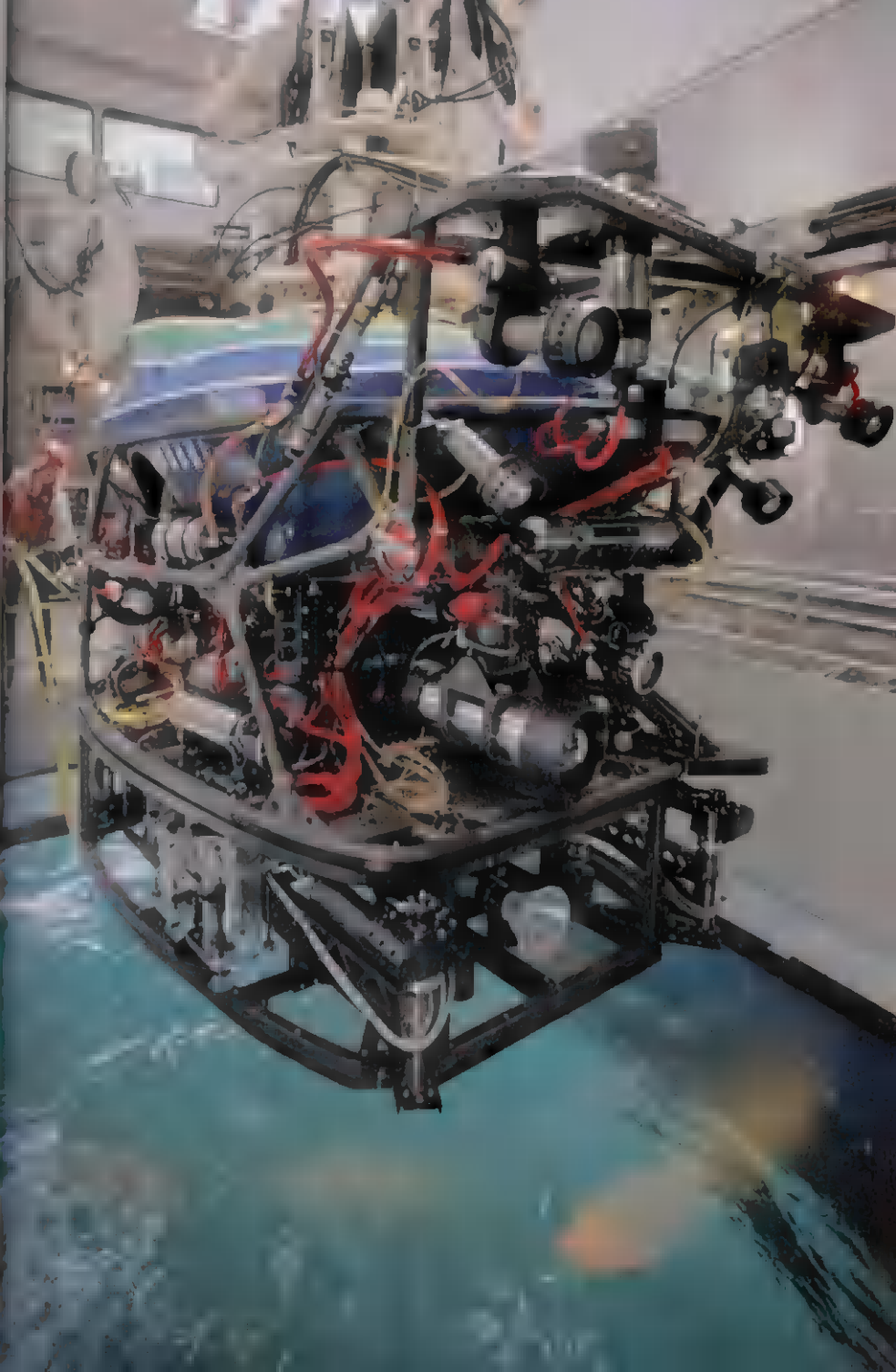
The animal does not in the least resemble an earthly mollusk—an organism like a snail, oyster, or mussel with a firm shell protecting its soft body and that travels, if it must, on a single, podlike foot. This one is swimming free in the deep, dark waters of Monterey Canyon off California, more than a mile down, although the word “swimming” doesn’t quite capture the creature’s ethereal, yoga-like moves.

For a long moment it is quiet in the control room of *Western Flyer*, the state-of-the-art research vessel of the Monterey Bay Aquarium Research Institute,



Bristling with lights, cameras, and specimen-collection gadgets, the unmanned submersible *Tiburon* (right) hangs over a hatch in its mother ship, *Western Flyer*. Both craft are operated by the Monterey Bay Aquarium Research Institute (MBARI). The submersible—able to dive past 12,000 feet—opens a new window on the deep for investigators like MBARI senior scientist Bruce Robison (left), watching as *Tiburon*'s camera tracks a squid.

EMORY KRISTOF (BOTM)





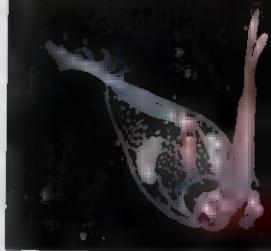
Shaped like a snail, but doing a passable imitation of a jellyfish, the so-called mystery mollusk (top left) is the subject of intense scrutiny. Scientists discovered it four years ago in the canyon, living at depths down to 10,000 feet, but still don't know how or what it eats. "No one has ever seen anything like it before," says Bruce Robison, who's working on a scientific description of the creature. The gluttony of the gulper eel (top right) is better understood. With

mealtimes few and far between, it compensates with big portions. The eel swallows animals as large as itself through wide-swinging jaws.

It takes skill and a steady hand on the controls to bring specimens back to the lab. From the surface, a pilot maneuvers *Tiburón* to snare a drifting jellyfish (above) in the six-inch opening of a specimen-collection cylinder.

PHOTOS FROM TOP LEFT: (COURTESY) MICHELE L. H. MARIANI AND NATIONAL DEEP SEA CENTER; (COURTESY) BRUCE ROBISON; (COURTESY) MARIANI; (COURTESY) BRUCE ROBISON; (COURTESY) MARIANI

The cockatoo squid cloaks itself in transparency, but its eyes are the flaw in its disguise. They block surface light, and predators below can see a silhouette. So the squid employs a trick of nature—bioluminescence—to match the light from above and hide its eyes.



GALATHEIDRIS PHYLLODIA © PHIL MURPHY

“Holy smokes! How long has it been since we’ve seen one of these?”

where Robison, a bearded, graying Neptune, reigns as chief scientist. Next to the captain his word is law here, and he’s seldom without something to say. But he now sits silently with his fellow oceanographers, peering at the mollusk’s image on *Flyer*’s bank of color monitors. There’s only the sighing sound of the ocean heaving against the ship and, like a soft echo, the sound of the scientists’ breathing.

Robison is the first to break. “How the hell does this animal work?” His question, asked with delight and frustration, illustrates how little is known about life in the ocean’s deepest waters—even these waters about 60 miles offshore.

Robison’s view of the beast, as he affectionately refers to this as yet unnamed species, comes from cameras mounted on a submersible vehicle named *Tiburón*, connected to *Flyer* via a data-transmitting cable. Equipped with a special buoyancy system and stuffed with high-tech gear, *Tiburón* can float quietly beside any animal and transmit real-time video of its every move to the scientists aboard the mother ship.

The beast bends and folds with the grace of a ballet dancer. Somehow its strange choreography must indicate how it lives, hunts, and reproduces. But none of its movements make sense to those of us from terra firma.

“We’ve caught a few of these in the past couple of years, but we still don’t understand how they use all their parts or what they eat.” Robison addresses the beast: “What do you catch? And how do you do it?”

“Must be something slow and stupid,” suggests one of the scientists. “The beast’s not exactly built for speed.”

Robison chuckles in agreement. “Nope. But he’s a predator, like everybody else down here. Maybe he eats eggs?”

Robison is certain that he will find the answers—if not on this dive, then perhaps the next. After all, this is only the eighth of these animals that Robison has ever observed.

His confidence stems from the richness of Monterey Bay and from the combined capabilities of the 117-foot *Flyer* and its robot submersible. Together the vessels are giving scientists their first glimpses of some of the deepest parts of Monterey Canyon.

Hidden by the ocean’s waters, the canyon begins a few yards off the California coastline. It descends gradually, eventually extending a hundred miles into the Pacific; water depths reach more than two miles in places. The canyon’s network of valleys is as bountiful as a rain forest. Sea stars, anemones, and corals encrust its terraced precipices. Fish, crustaceans, jellies, mollusks, squid, and octopuses navigate its dark waters. Colonies of clams, tube worms, and uncounted varieties of bacteria ooze from its cold seeps.

Over the past four years, Robison and his team have made nine expeditions to the lower reaches of the canyon—a zone of frigid waters where sunlight never shines, a world of little oxygen and great pressure—finding new animals and puzzling out their behaviors on nearly every trip. “It’s a world so unlike our own that we really shouldn’t be surprised to find animals that defy our imagination,” says Robison, finally peeling his eyes from the mystery mollusk on his screen. “The deep sea is the largest habitat

on our planet, and yet it's still the most unexplored. That's why every time we come out here, we're almost guaranteed to find something new. We're like 19th-century explorers, out here in a world no one has seen before."

The team members aren't just trying to bag new oddities from the sea; they're seeking to understand the canyon's overall deepwater ecology and the natural history of the animals they encounter. "There are animals down here that scientists know about because they've caught them in their trawling nets," Robison says. "But no one has seen them swim, feed, or reproduce. Now look at us. We're filming every move this guy makes. We'll be able to study that later and try to make some sense of him."

Just then an inch-long, white butt worm (so-named because of its resemblance to a cigarette butt) drifts into view. Instantly Robison's colleagues break into an eager and lusty chorus: "Eat it! Eat it! Eat the butt worm!"

"We used to bring up all kinds of dead and beaten-up animals, little bits of white goo and jelly stuck to the nets."

But the mystery mollusk does not. No tentacle shoots out. No poisoned dart is launched to grab what other residents of the deep—and apparently some of *Flyer's* scientists—regard as a tasty meal. The beast merely continues its curious undulations, oblivious to the creatures from above who so hungrily monitor its every move.

Scientists began an earnest exploration of deep-ocean marine life in 1872 when the British government sent H.M.S. *Challenger* on a three-and-a-half-year voyage around the world with a charter to discover what lurked in the waters below. As implausible as it may seem today, researchers then generally deemed the deep-sea environment little more than a watery desert, too harsh to support life. Many were thus astonished when, after dragging her nets from ocean to ocean and dredging the seafloor, *Challenger* returned stuffed to her gunwales with more than 4,000 new species. There were bizarrely shaped sea stars and worms, fantastic crabs and fishes, including anglerfish from whose forehead sprouted a stalk with a dangling, bioluminescent lure.

Spurred by *Challenger's* biological trove, other researchers began dragging and dredging to search the seas for exotica.

"And that's what people did for about a hundred years," Robison says early the morning after we saw the mystery mollusk, as we watch the ship's crew prepare *Tiburón* for another dive. "We used to bring up all kinds of dead and beaten-up animals, little bits of white goo and jelly stuck to the nets. We had no idea what they were, although there were tantalizing hints. Things like, 'Wow! This piece of Jell-O caught this fish! How did it do that?'"

Other pieces of Jell-O were "breathtakingly beautiful," Robison recalls, "like holding a bit of rainbow in my hand or discovering a feather without ever having seen a bird. What kind of forest ecologist would settle for that?"

Robison found a way into the ocean's forest via submersibles, first with a manned expedition and later using remotely operated vehicles

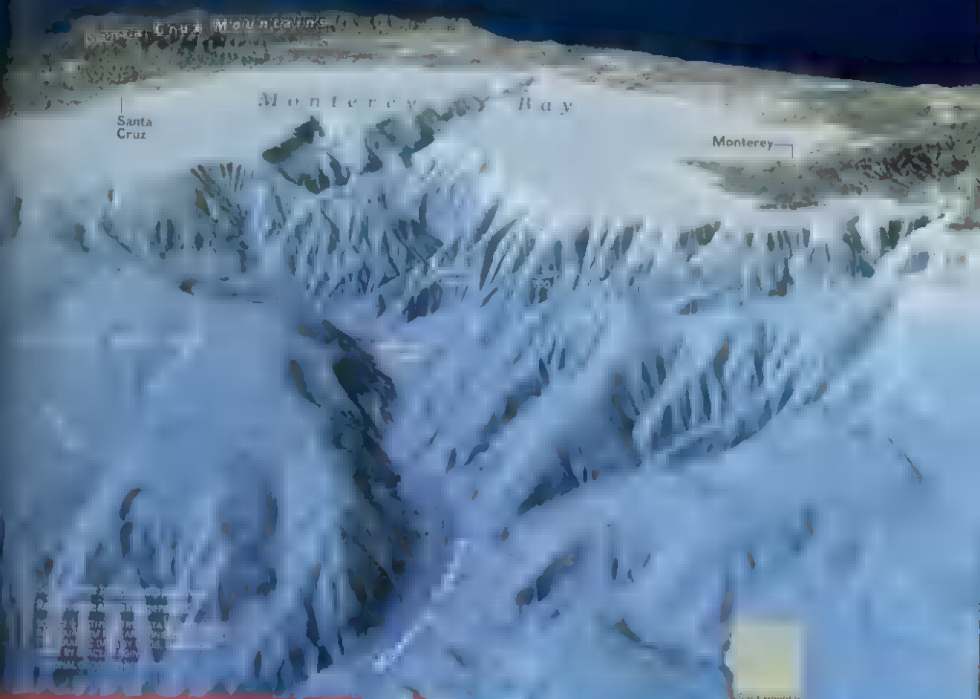
(ROVs) like *Tiburón* and its older sibling, *Ventana*. With their video and still cameras, remote-sensing gear, and collecting equipment, ROVs can gather enormous amounts of data.

Robison says he used to tell people what he saw on the manned submersible dives. "No one believed me," he laughs. "Now I show them the photographs—and sometimes the specimen."

Below us *Tiburón*, yellow and blue, and about the size of a small SUV, sits tethered in *Flyer's* center hull. Two of the crew give the ROV a final check before its dive, and Robison ducks into the control room to man his station. An operator seated at a crane above the submersible lifts the vehicle from the ship's floor. The hinged floor opens, revealing a sloshing square of turquoise. He positions *Tiburón* above the square. It dangles there, swinging in time with the rhythm of the ship and the sea.

"We're ready for release," says ROV pilot David French, radioing to the control room.

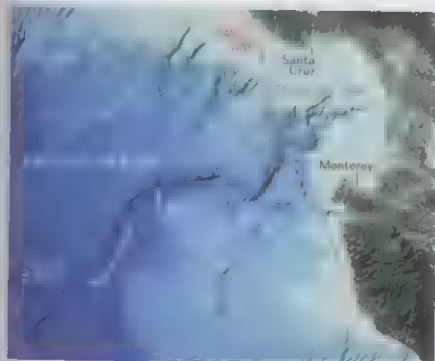
"Any time then," the word comes back. A moment later *Tiburón* splashes into the water and quickly disappears.



Grand Canyon of the Sea

Beginning as a tiny gully just a short swim from California's central coast, Monterey Canyon quickly slices through the shallow plateau of the continental shelf. About a hundred miles long and with water depths greater than two miles, the canyon funnels the bounty and mysteries of the deep Pacific practically into the MBARI scientists' backyard. "We can leave the dock at Moss Landing at 7 a.m., and by 8:30 we're in 2,000 meters [6,562 feet] of water," says MBARI marine biologist George Matsumoto. The submarine canyon is often compared to Arizona's Grand Canyon, but the geologic forces that created

it remain a subject of debate. Researchers are certain Monterey Canyon formed underwater, and therefore couldn't have been cut by a flowing river. They suspect catastrophic events such as avalanche-like flows triggered by earthquakes or floods. A major fault bisects the canyon, and MBARI marine geologist Charlie Paull has documented powerful currents—temporary and unpredictable—that move huge volumes of sand, among other things. "I've lost sensing devices that weigh 800 kilograms [1,800 pounds]," Paull says. "Some I find hundreds of meters down the canyon, mangled and partly buried. Others I never find."



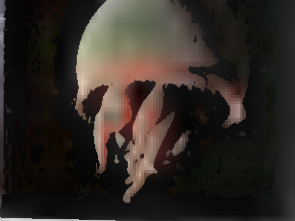
**"Most of the animals we'll see in
midwater are predators. It's a
dog-eat-dog world down here."**





If shrimp could dream, the fish called fangtooth would be their nightmare. Its powerful eyes enable it to hunt in sight in murky depths more than 1,000 feet below the surface. Shown here a bit larger than life-size, the ruggedly armored fish is typically about six inches long.

ANOPLOGASTER CORNUTA (CAPTIVE SPECIMEN)
BRUCE ROBISON



Strange arms dangle beneath the bell of this massive jellyfish, which was dubbed "big ugly" when it was discovered. Scientists later warmed to its

size and hue and renamed the animal "big red." It can grow to more than three feet in diameter.

TITULOMIA (GRANIBER) RABIERI

"Every time we come out here, we're almost guaranteed to find something new."

All action is now in the control room, dark except for the images on the monitors and the flickering lights on the control panels. Paul Tucker, *Tiburon's* pilot for the morning shift, sits a few feet away from Robison in a *Star Trek*-style command seat, his hand firmly on controls much like those of a video game. It's Tucker's job to "fly" *Tiburon* (as the scientists say) and direct its collecting devices if the scientists spot an animal they want to bring to the surface. Robison sits in a similar seat, with a screen directly in front of him and a separate control box for the cameras, focusing and zooming in on whatever he finds interesting.

Tiburon sinks through the first few hundred feet of ocean within five minutes. The light in this narrow band of water provides enough energy for tiny plants of phytoplankton to grow. Nearly all life farther down depends, directly or indirectly, on the phytoplankton in these upper waters, where insect-like copepods and krill feed on it like deer grazing in the forest. The copepods and krill, in turn, are fodder for a large variety of predators that lurk in the darker midwaters where light is minimal—and where plants, consequently, never grow. "Most of the animals we'll see in midwater are predators," says Robison. "It's a dog-eat-dog world down here."

Tiburon continues dropping through the jade world of the surface waters. The ocean grades into a richer turquoise and then a royal blue, which gradually grows inkier as the ROV flies into the unknown. The submersible's cameras look out on a world illuminated by the merest hint of sunlight; only *Tiburon's* strong underwater lights, which cast a glow close to that of

daylight, allow us to see anything. And initially most of that anything appears to be dandruff.

"That's marine snow—or, less politely, sea snot," says Steven Haddock, a specialist on bioluminescent jellies. "It's a lot of organic material: bits of dead animals, plant cells, fecal pellets."

The ocean's garbage, in other words. But it is pretty garbage: a dense snow of white flakes falling and swirling in an indigo world. And it's important garbage, as Robison explains.

"We've always been surprised by how much life is found on the ocean's floor," he says. "What provides the sustenance for it? Some of it is this detritus, this constant organic rain, but a lot of it, I think, is from the discarded filter houses of some animals we should see pretty soon."

In the next instant, as if on cue, Tucker homes in on a giant larvacean, *Bathochordatus charron*—which, despite its long name, is the size of a tadpole. Larvaceans, using mucus extruded from glands inside their bodies, spin nets to trap food particles much as spiders spin webs to trap insects. Some of these nets, or filter houses as the scientists call them, extend more than six feet.

"Good, he's home," says Robison, moving a lever on his control panel to zoom in on the animal, and filling the monitors with its image.

Inside the large house of mucus is a smaller, butterfly-shaped structure the larvacean has also built: its feeding filter. And inside of that, fluttering like a moth, is the larvacean itself, a flat, transparent ribbon of a being. Its tail beats a steady pulse that pumps water, particles, and microscopic plankton through the filters, leaving the choicest bits for the larvacean to gobble. When the mucus threads of its home get too



gummed up with food. *Bathochordaeus* simply swims away, then builds a new house. "We think their discarded houses take a lot of organic matter to the floor, the benthic zone," says Robison. "Just look at how gummed up this one is. Yummy!"

"We'd love to see one leave its old house and start in on a new one," adds Robison. "We've tried many times to keep these guys alive in our

The vampire squid is not really a bloodsucker—it just looked a bit devilish to the scientist who named it. The species is 300 million years old, perhaps a precursor to today's squid and octopuses. Its meaty fins (top right) help it swim and steer. If it meets an even scarier foe, it pulls its arms back over its body in a defensive display (top left).

VAMPIROTEUTHIS INFERnalis © IN. ALL CAPTIVE SPECIMENS: KIM REISENDIENGER

lab, but they're so fragile, they just don't last long enough."

The liquid world of the midwater zone has no corners or walls, so many animals here that lack shells, including larvaceans, are safe from the damaging effects of bumping into hard surfaces. But aquariums are altogether different. Although researchers contain such animals in large aquariums with circulation systems designed to keep them away from the walls, inevitably there are collisions, and the larvaceans die.

We watch the larvacean flutter inside its house a while longer. Small white particles are stuck along all the filaments. Then Robison tells Tucker to bring it in. Robison has a new aquarium at the institute and hopes that this time the larvacean will survive and surrender its home-building secrets.

Pushing various buttons on his control panel, Tucker moves the submersible's swing arm to position a wide-mouthed jar directly below the animal. He maneuvers the vessel upward to surround and capture the larvacean.

in the midwater column need to be neutrally buoyant, and so this heteropod's shell has nearly disappeared, and its single foot has grown into a muscular swimming fin. Two large eyes project on small filaments from either side of the snail's trunk-like head. (Despite the almost complete absence of sunlight, many animals in these depths still have eyes and use them in the faint light to spot their prey, often zooplankton, and to watch for predators.) Tucker catches the snail, using the submersible's suction nozzle to gather it into a jar, then guides *Tiburón* farther down.

The other four scientists in the control room grow more attentive with every foot *Tiburón* drops. Are they expecting something? "Between 200 and 700 meters [650 and 2,300 feet] is biologically the richest part of the midwater column," Haddock explains. "This is where we're going to get some good animals."

It's a forbidding region for landlubbers like us—40°F, oxygen poor, crushingly deep—but not for the creatures that call it home. At first I see nothing but the snow, but as I follow the

"The deep sea is the largest habitat on our planet, and yet it's still the most unexplored."

The press of another button closes the lid.

We're down to 650 feet now. We can see only what the cameras see, and while they are angled to give a 270-degree view, the view is still much like peering at the ocean with one eye through a pipe, as Robison puts it. He leans forward, biting his lower lip, watching the snow fall, as thick as a blizzard now. At this depth we are just below the photic zone, a level reached by barely one percent of the sunlight that touches the ocean's surface.

"All stop!" Robison barks. "Holy smokes! How long has it been since we've seen one of these?"

He focuses the camera's lens on what first appears to be a large, white blob. But as it comes into view, the blob assumes the shape of a leaf with an elephant-like trunk.

"It looks like a confused mess," says Tucker.

"Well, it's a heteropod—a snail," says Robison, "but its shell has been greatly reduced." He points to a thin white bar at the base of the "leaf." "That's all that's left of it."

Although closely related, this swimming snail looks nothing like its terrestrial cousins. Animals

scientists' eyes I'm able to pick out what they see and realize that there are animals everywhere: tiny oval jellyfish trailing long tentacles like kite tails; a caterpillar-like polychaete that shimmers blue and purple ("Hey, it's Elvis," the scientists joke). There's a jelly shaped like an angel's halo and another so transparent we can see in its gut the orange krill that it had for breakfast.

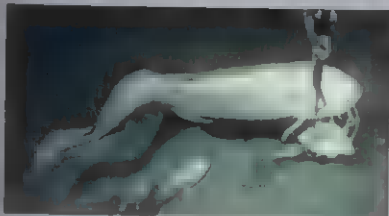
We watch a siphonophore, a creature that seems to be not much more than an unraveling rope with a string of stomachs and tentacles attached, and radiolarians—colonial, amoeba-like animals that join together in sets of eight to build Buckminster Fuller-type houses of brittle silicate strands. Dark squid rocket by, while silver hake wriggle into the glow of *Tiburón*'s lights. There are dozens of larvaceans and empty larvacean houses, so covered with chunky flakes of marine snow, bacteria, and other detritus that they look like yesterday's onion rings. Without their makers inside to keep them aloft, and weighed down by all the organic matter, they sink like collapsed parachutes.

Nearly every creature we see at this depth—




Bringing Bait to the Bottom

On the floor of Monterey Canyon, at a depth of 6,000 feet, a tangle of rattail fish and ■ solitary crab (above) swarm the tastiest meal they're ever likely to get—a brew of tuna and enzymes specially cooked up by former MBARI scientist Mario Tamburri, an expert in the scents and tastes that drive marine animals wild. "Adding the enzymes to the bait enhances its attractiveness probably a thousandfold," he says. Tamburri concocted the solution ■ lure fish to photographer Emory Kristof's "ropecam," ■ camera dangling from the end of a very long rope. Kristof developed the technique a decade ago as a low-budget, stealthier alternative to the noisy submarines and unmanned submersibles of the day. "When the fish see this multi-ton thing rigged up with lights rumbling along the bottom, stirring up clouds of sand—that's a sea monster," he says. "They get out of there." Scientists can now photograph and catalog in the zone between 5,000 and 6,000 feet deep, which ■ especially rich in sea life—a bounty that hasn't gone unnoticed by commercial fishing fleets. Bottom trawlers now have the technology to reach depths of 6,000 feet, raising concerns among many marine biologists and others. "We don't even know yet what's down there,"



says Kristof, who has spent years photographing deep-sea species. "We can't know what effect fishing will have." Going even deeper, another ropecam image filmed 10,000 feet below the surface (left) shows ■ mammoth seven-foot-long cusk eel—a member of the fish family that includes the deepest-dwelling fish species known—bellying up to the bait dispenser for an enzyme-enhanced treat.



Even the canyon's more outlandish looking residents are perfectly adapted to their extreme environment. This three-foot snipe eel has a beak with tiny teeth that grab shrimp antennae. The seven-inch eelpout (right) curls up to resemble a jellyfish, unpalatable to some predators. Growing to around six feet long, the ribbonfish (below right) propels itself by the undulations of its long dorsal fin.

CLOCKWISE FROM LEFT: *NEPHTHYUS SCORPIONCEUS* (CAPTIVE SPECIMEN); BAUCE WORMSON; *LYCODAPLUS MANIBULARIS*, SEA STUDIO'S BELL; *TRACHYPTERUS ALTVELIS*, SFRARI



"It's a world so unlike our own that we really shouldn't be surprised to find animals that defy our imagination."

fish, squid, invertebrates—is bioluminescent, equipped with special organs called photophores that emit light via chemical reactions. Most of the animals produce the light themselves with special proteins, but others rely on luminescent bacteria that live inside their photophores for their otherworldly glow. Some jellyfish acquire their lights only by eating other luminous species. Scientists remain unsure as to why so many deep-ocean species need to shine, but since nearly 90 percent of the animals here can do so, there must be a strong advantage.

"The standard hypothesis is that the light frightens away predators, but some use it to attract prey or send signals to potential mates," says Haddock. "Others use it to hide."

Hiding is key to surviving in this predaceous world. But it's tricky to hide in what amounts to pure open space. One technique is to be transparent like the larvaceans and many other gelatinous animals. But that doesn't work for species with more body mass, such as squid and fish. Several of these species have devised ways to hide behind their bioluminescence—although using lights to hide in the dark seems like something only a fool would try. When we see a cockatoo squid, Haddock shows how this optical trickery works.

As this squid's name suggests, it looks like a cockatoo, with its tentacles gathered in a feathery, crestlike fashion. The squid appears white to us although its body is mostly transparent, protecting it from visual predators in the depths. The squid's eyes, however, are opaque. "Predators often come at their prey from below," says Haddock, "and the opaque parts of animals higher up in the water column cast a silhouette that can alert hungry fish."

To erase these shadows, the cockatoo squid has evolved U-shaped photophores at the base of its eyes. The photophores emit a blue glow

that effectively cancels the squid's eye shadows. Lanternfish are similarly equipped, with a row of blue-light-emitting photophores along their bellies to hide them from a predator's fangs.

"What do you know?" Robison suddenly exclaims. "It's *Vampyroteuthis!*"

On the screen, a dark, bat-like creature with eight arms and iridescent eyes the size of marbles flaps slowly in the glare of *Tiburón's* lights. A living fossil, *Vampyroteuthis* is the last representative of a lineage of animals that may have given rise to modern-day octopuses and squid. Since Robison typically spots one of these rare, archaic animals only once a year, he settles in to watch and film it.

"There are so many things about it that we don't know: What it eats, how it generates the bioluminescence on the tips of its arms, or what these extra tendrils are for," he says, pointing to two long, trailing filaments. The animal can coil these up in two pockets between its third and fourth arms. But unlike its other eight arms, these two lack suckers. "I don't have any evidence, but I think it uses them as chemical sensors," says Robison. "The deeper we go, the darker the ocean gets. Senses other than sight become more important."

After Tucker collects the *Vampyroteuthis*, David French replaces him at the controls. We fly down steadily, reaching a mile below the ocean's surface, then a mile and a half. The marine snow continues to fall, but it's sparser now, and there are few animals about.

"This is the hardest place in the water column to make a living," says Haddock. "Very little food gets to these depths, so the animals you do see tend to be large and rare."

It is here that the team has found a new jellyfish, one twice as large as a family-size pizza. They've named it *granrojo*, Spanish for "big red." Robison hopes to see more of them on this trip, but they elude him.

"This is really an opportunistic science," he shrugs. "You make a dive and take what you get. What we see varies from year to year and season to season. But even that is important—it

TAKE A DIVE Sink two miles into the sea from the deck of *Shana Rae* with photographer Emory Kristof's "ropecam," and view video of life on the floor of Monterey Canyon at nationalgeographic.com/magazine/0406.



tells us there are cycles to these animals' lives and gives us another puzzle to solve."

A few moments later French announces, "Bottom contact on sonar." The seafloor rolls out like a soft, beige carpet. Robison points to tiny purple jellies floating just above the floor. Beyond them, lying on the floor itself, are several bumpy sea cucumbers, sea stars with skinny legs, pink anemones, and tube worms, which quickly retract their feathery feeding arms at *Tiburon's* approach. A single rattail fish hangs inches above the bottom, shoving its snout into the sediments in search of a meal.

"Very few people," Robison says softly, "have ever seen this part of Earth before."

We crowd around peering at the screens, wishing for a larger view, wondering what mysteries lie beyond the lights of *Tiburon*.

Robison heaves a sigh. "Time's up," he says.

A fiery red gonatid squid cannibalizes another of its kind that has faded to deathly white. The squid—capable of swift changes of color and pattern—forage from the surface to more than 6,000 feet deep, embodying the mystery and beauty that draw researchers to the inky depths of Monterey Canyon.

GONATOS ONKIKING NIBARI

Tiburon has been submerged for about nine hours. "Let's head for the top."

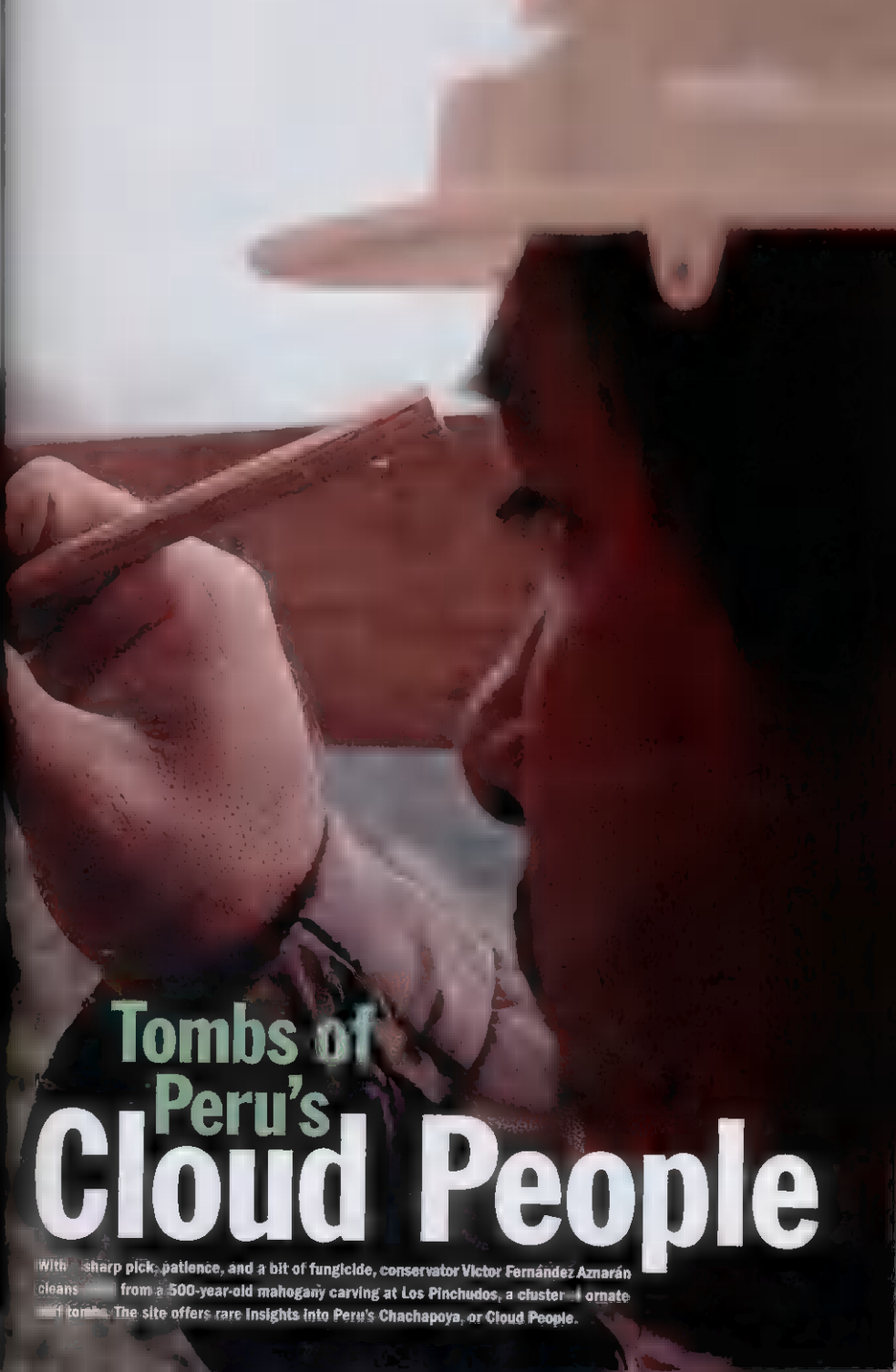
Three hours later the submersible emerges from the water. The scientists dash for their collecting jars, rushing to place their new animals in cold rooms and aquariums—hoping that some will live a few hours, days, or even months longer, to tell us more about what they are and how they exist two miles down in the land of marine snow. □

**NATIONAL
GEOGRAPHIC
RESEARCH AND
EXPLORATION**



GRANTEE
Warren Church
Archaeologist
Columbus State University,
Georgia

"The region, one of the South's most beautiful and haunting landscapes, is full of ruins."



Tombs of Peru's Cloud People

With sharp pick, patience, and a bit of fungicide, conservator Victor Fernández Azarán cleans from a 500-year-old mahogany carving at Los Pinchudos, a cluster of ornate tombs. The site offers rare insights into Peru's Chachapoya, or Cloud People.

By Peter Gwin

NATIONAL GEOGRAPHIC WRITER

Photographs by Ricardo Morales Gamarra

Shoulder to shoulder and nearly naked, gnome-like statues have stood for centuries at Los Pinchudos, a stone-and-plaster complex of nine tombs built into a high rock cleft in one of Peru's northern cloud forests. The two-foot-tall mahogany carvings bore silent witness as waves of looters hiked up to ransack the burial chambers. Vandals even hacked down one of the six unusual statues, whose robust male anatomy inspired the name Los Pinchudos (slang for "the big penises").

By the time locals led researchers to the site in 1980, the tombs were nearly empty.

of the dense cloud forests in the mountains between the Marañón and Huallaga Rivers. Inca contemporaries called them Chachapoya, the Cloud People. Although they left no written language, they did leave scores of stone ruins in this vertical wilderness of orchids, butterflies, and jaguars, where thick brush and mists camouflage sheer drop-offs. "You can literally find your legs dangling over empty space, your armpits supported by tree branches," says Church.

For more than 500 years the Chachapoya cut farm terraces and villages into these steep slopes, raised llamas and guinea pigs—and fought each



Heads were on the line as conservators restored the site's foundations (opposite). "One miscalculation could've sent it tumbling," says archaeologist Warren Church. Among its treasures were these 15th-century stone faces.

Yet the absence of mummies hasn't deterred archaeologist Warren Church, who's worked for 19 years to save Los Pinchudos and learn its secrets.

Little is known about the hill tribes that in the tenth century began carving settlements out

other. Around 1470 the Inca conquered the region. When Spaniards arrived in 1535, the surviving Chachapoya joined them to rout the Inca, impressing the Europeans with their battle prowess. By 1700 smallpox and other diseases had

THE PROJECT

LOS PINCHUDOS: Most elaborate Chachapoya tomb complex
GETTING THERE: Three-day trek through Andean cloud forests
OBSTACLES: Thin air, landslides, floods
SCARIEST MOMENT: Giant boulder nearly flattened archaeologists' camp
SITE'S STATUS: Located in Rio Abiseo National Park, a natural and cultural World Heritage site that's guarded and closed to all except scientific missions

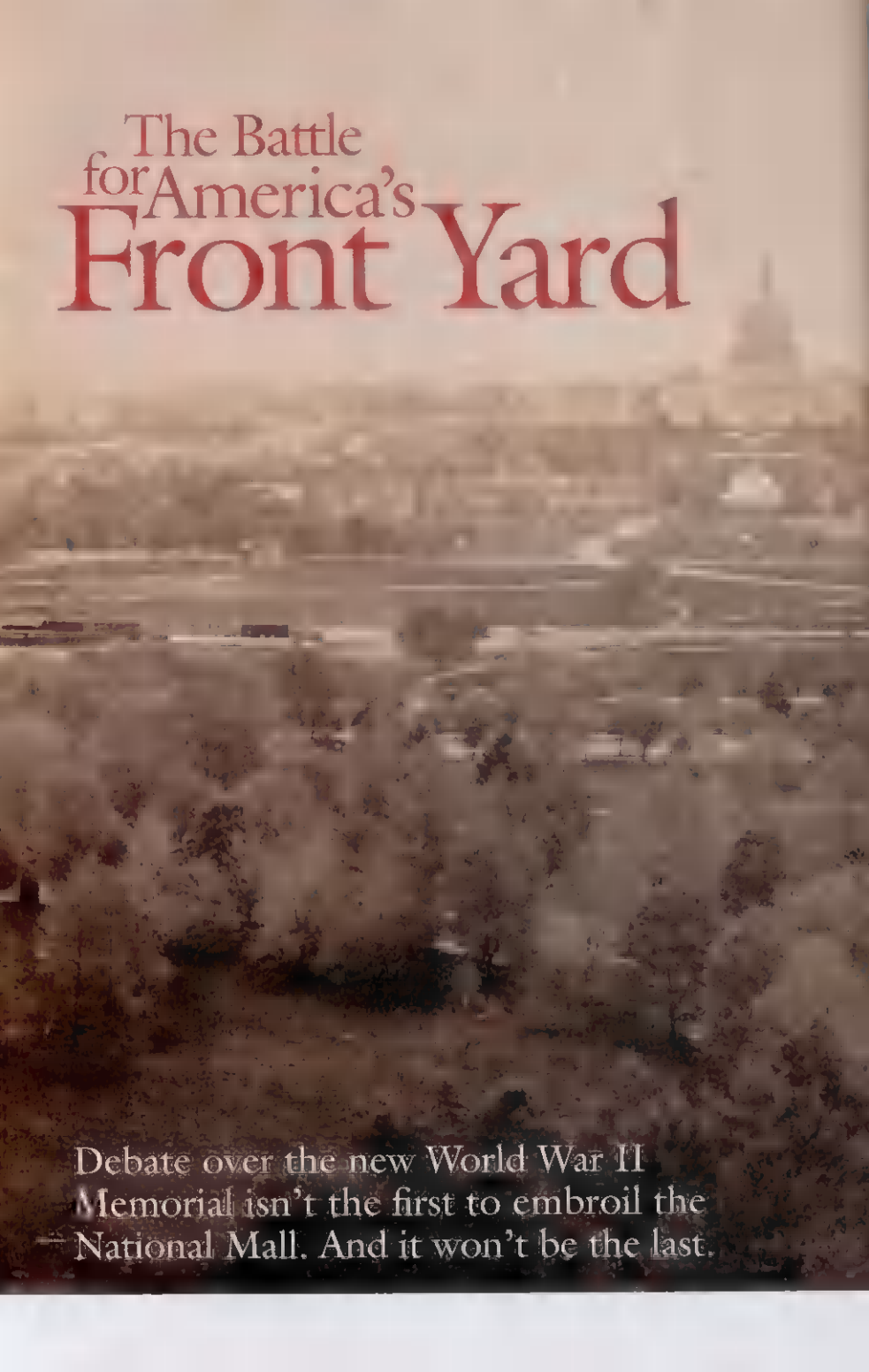
killed most of the Chachapoya.

Los Pinchudos is a vital link to this lost people. Researchers don't know who was buried here but think the tombs relate to Chachapoya ruins nearby at Gran Pajatén. Even in its looted state the site has yielded tantalizing artifacts such as shell jewelry, which suggests contact with coastal people. Most surprising are the statues. Wood artifacts rarely survive the cloud forests' extreme humidity. Scientists attribute the figures' preservation to the site's location in an arid microclimate.

The tombs might have been lost without Church and Peruvian conservator Ricardo Morales Gamarra, who, with World Monuments Fund support, restored the eroding foundations. Church believes Los Pinchudos and its surroundings will teach volumes about this extinct culture: "My mind races, thinking of what the forests still hold." □

LIFE IN THE CLOUDS Want to learn more about the Cloud People and their cliff tombs? Find recommended websites and a bibliography at nationalgeographic.com/magazine/0406.





The Battle for America's Front Yard

Debate over the new World War II Memorial isn't the first to embroil the National Mall. And it won't be the last.



1879 In the wake of the Civil War, the United States Capitol overlooked a vast public space that, like the character of the nation itself, was still a work in progress. It remains so today, as groups argue about whether there should be more monuments on Washington's most prized public real estate.

PHOTO: NATIONAL ARCHIVES

The Mall: Asking for a Little Respect



2003 Aretha Franklin belted out the national anthem at a four-day spectacle that managed simultaneously to salute U.S. troops, promote a soft drink, launch the NFL pro football season, and provoke the Mall's protectors to cry foul.

NATIONAL GEOGRAPHIC PHOTOGRAPHER MARK TSBIRNY



By Cliff Tarpay

NATIONAL GEOGRAPHIC SENIOR WRITER

The grandest stage in the United States—the National Mall in Washington, D.C.—is rarely quiet. People swarm here to visit museums, protest injustice, or simply play. Even when the Mall is quiet, it's thunderous, reverberating with history and memory: for instance, a family leaving a flag beneath the name of a loved one etched into the granite of the Vietnam Veterans Memorial. And now, after stinging debate, people can come to pay homage to the 405,399 Americans who died in World War II.

Inspired by formal French designs like the Palace of Versailles, Pierre Charles L'Enfant, who laid out Washington in 1791, envisioned the Mall as a grand avenue with stately gardens. It hasn't turned out that way. As it bore witness to the progress and travails of a boisterous nation, the Mall has been torn up, redesigned, hemmed in by a growing city, and altered for security. The Mall's stewards face the tricky task of balancing competing demands. Groups work to erect memorials. Preservationists try to block them, hoping to perpetuate the Mall's open vistas. The issue: When does use become overuse?

Recasting L'Enfant's Grand Design



1902 An expanded vision drawn up by a commission created by U.S. Senator James McMillan sought to undo decades of neglect, the result of a lack of funding that had left the original plan of Pierre Charles L'Enfant barely

implemented and often ignored. Railroad tracks, power plants, fish-breeding ponds, cheap housing, and brothels marred the area. The McMillan plan (above) led to clearing and lengthening the Mall onto parkland that had been reclaimed from the Potomac River. The plan also surrounded the space—along with the White House and the Capitol—with monumental, classical buildings and museums. Now, a century later, the Mall's overseer, the National Park Service, hopes to raise 30 million dollars for improvements through the private Trust for the National Mall. Plans include renovation of the Reflecting Pool and Constitution Gardens Lake.





1935 As workmen graded the Mall, a statue of Joseph Henry, the Smithsonian's first secretary, faced the Castle—the only Smithsonian building until 1881 (facing page, bottom; No. 1 on tear-out map). Before 1935 the Mall had been balkanized as some occupants did their own landscaping; the Castle once had a pen for a collection of animals. Henry lived in the Castle from 1855 to 1878.

1946 The city's explosive wartime growth brought traffic snarls—and a radical proposal: twin expressways and underpasses for north-south streets (along with an inner-city beltway). The failed plan would have turned the Mall into a median strip. In 2003 a controversial proposal for an underground visitors center and entrance tunnel at the Washington Monument was also scrapped.



CAPITOL HILL EXPRESSWAY

Witness to a Torn Nation



1865 Vengeance belonged to the North (top) as Henry Wirz, the Confederate commandant of Georgia's Andersonville prison, dropped to his death near the Capitol.

1963 "I have a dream." Rev. Martin Luther King, Jr., electrified a crowd of 250,000 people seeking racial equality with one of the most famous speeches in U.S. history.

Ever Shifting Ground

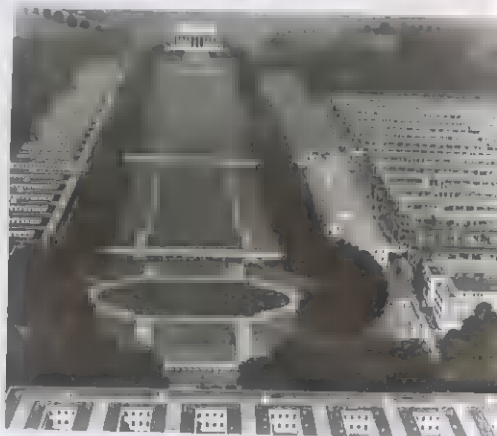
In the 1860s, arabesque pathways graced the Castle and the White House (tear-out map at right), but the Mall looked better than it smelled. In summer the stench of slaughtered cattle, offal, and sewage dumped into the Washington Canal drove President Lincoln to flee to a retreat at the Soldiers' Home on the edge of town. By 1900 the Washington Monument towered above the city, and the canal was gone. The 1940 map shows the Lincoln Memorial, built on reclaimed land, offering a splendid view over the Reflecting Pool, which terminated at the Rainbow Pool. By then, several of the Smithsonian's growing roster of museums sat facing the Mall.

Remembering the Valorous

1920 The Lincoln Memorial anchored the Mall's west end, which would have pleased John Hay, Lincoln's personal secretary: "[He] was of the immortals. Lincoln, of all Americans next to Washington, is entitled to that place of honor."



1943 Aesthetics bowed to efficiency in World War II. Walkways over the Reflecting Pool connected tiers of temporary military buildings not completely removed until 1970.



2004 Claiming a choice location, the World War II Memorial encompasses the Rainbow Pool. Pavilions symbolizing the Atlantic and Pacific theaters overlook 56 pillars representing the wartime states, territories, and District of Columbia. Legal efforts to block construction, led by the National Coalition to Save Our Mall, failed after reaching the U.S. Supreme Court, which declined to consider the issue.

NATIONAL PHOTO COMPANY COLLECTION, LIBRARY OF CONGRESS (TOP); LIBRARY OF CONGRESS (CENTER); NATIONAL GEOGRAPHIC PHOTOGRAPHER MARK THIESSEN



At War and at Ease



1865 Displaying cocksure poses, U.S. Treasury Guards were charged with defending the Treasury Building from attack by Confederate troops. Work on the Washington Monument, at upper left, had begun in 1848 but was suspended just before the Civil War when the private groups sponsoring its creation ran out of money. After the war, the federal government financed construction, which wasn't completed until 1884. The marble facing for the two phases came from separate quarries. The resulting difference in color left an enduring symbol of a nation divided and reunited.

1894 On any list of Mall oddities, the General Noble Redwood Tree House (facing page, top) would stand tall. Created in an era when trees were often named after prominent citizens, it was crafted when workmen felled a 2,000-year-old California sequoia called General Noble, then hollowed out sections that were later reassembled on the Mall. A Civil War officer, John Willock Noble served as interior secretary from 1889 to 1893, distinguishing himself, ironically, by championing laws to protect forests on federal land. The structure was removed from the Mall in 1930 and later destroyed.



1919 Swaying as one, young ladies skate over the frozen Tidal Basin, an activity offered today on the Mall at a rink inside the National Gallery of Art Sculpture Garden.

1928 Boys' imaginations sail away on the Reflecting Pool. Even today some visitors come just to fly a kite or to fish in Constitution Gardens Lake or the Tidal Basin. The big draws are the memorials and monuments, the National Gallery of Art, and the Smithsonian's nine museums (a tenth, the American Indian museum, opens this fall). All together they record 37 million visits a year.



From Pasture to Protest



1865 Cattle (above) grazed in front of the U.S. Treasury Building. The beef filled Union Army pots.

1930 Open spaces provided plenty of room for a U.S. Army blimp, a sight since replaced by helicopters occasionally landing on the Mall with the President and visiting heads of state.

1968 Resurrection City sprang up to house the mostly African-American marchers who flocked to Washington for the Poor People's Campaign against poverty. The Southern Christian Leadership Conference decided to proceed despite the assassination of Dr. King, its founder, only weeks before.



1935 As night descended, a visitor to the Lincoln Memorial gazed at the Washington Monument and the Capitol beyond. Some people still fear that memorials will clutter the Mall; others want their cause remembered at any cost. One idea being considered: setting up a planning group much like the Central Park Conservancy, which aided the renaissance of New York City's grand public space. Despite last year's passage of a law declaring that "no more commemorative works or visitor centers" will be allowed (other than three already approved), debate continues. Almost everyone has an opinion about what should be done with America's front yard. □

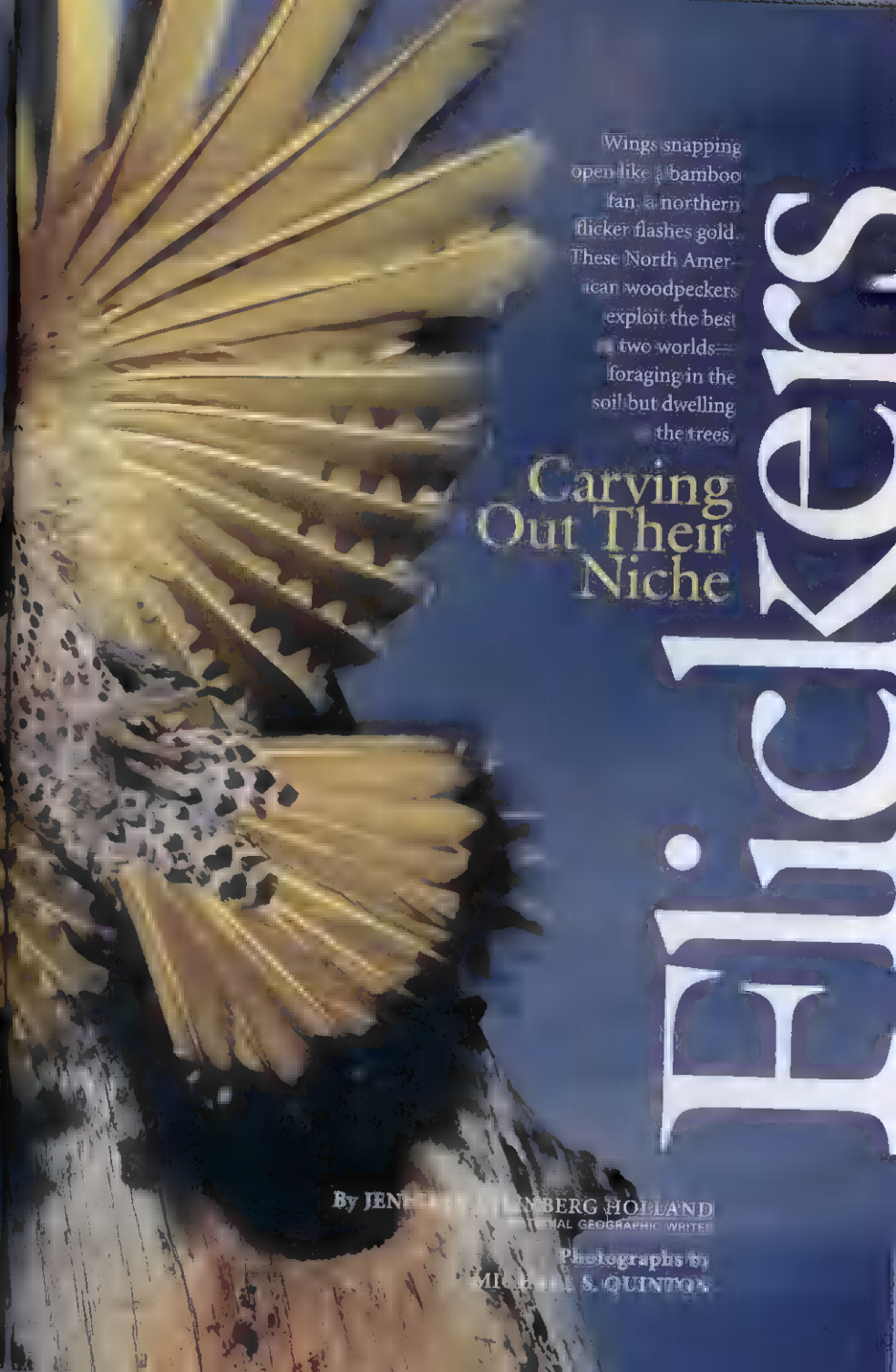


IS THE MALL OVERBUILT? Voice your opinion in our forum at nationalgeographic.com/magazine/0406.

NATIONAL ARCHIVES (TOP); THEODORE HORYDCZAK, LIBRARY OF CONGRESS (ABOVE); BETTMANN CORBIS (LEFT); VOLKMAR WENTZEL







Wings snapping
open like a bamboo
fan, a northern
flicker flashes gold.
These North Amer-
ican woodpeckers
exploit the best
of two worlds—
foraging in the
soil but dwelling
in the trees.

Carving Out Their Niche

Flickers

By JENNIFER LAMBERG HOLLAND
NATIONAL GEOGRAPHIC WRITER

Photographs by
MICHAEL S. QUINTON



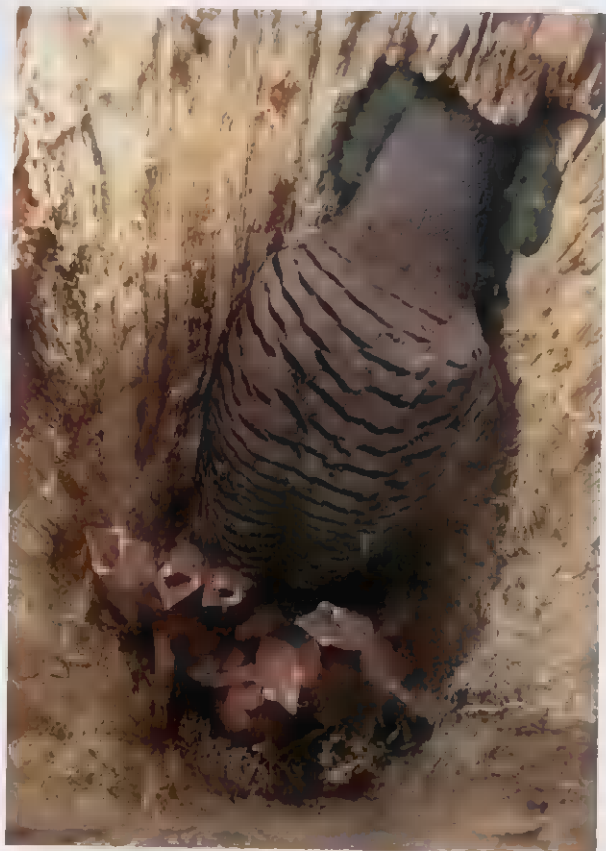


HOMEMAKERS

With long slender beaks poorly suited to hammering hardwoods, northern flickers (*Colaptes auratus*) choose rotting trees for chiseling out their homes. Yet those same narrow beaks can nab ants—the birds' main food—on the ground with uncanny precision. Cleared of debris by a mustached male (above), a hollowed-out spruce in Alaska draws two females to compete for both the house and its maker (left). The trio performs the “wicka” mating dance, a head-weaving, tail-flaring ritual named for the birds' calls. “They may dance for hours until the mates sort themselves out or settle territorial boundaries,” says University of Saskatchewan biologist Karen Wiebe. When two finally pair off, a branch makes a fine breeding post (right).

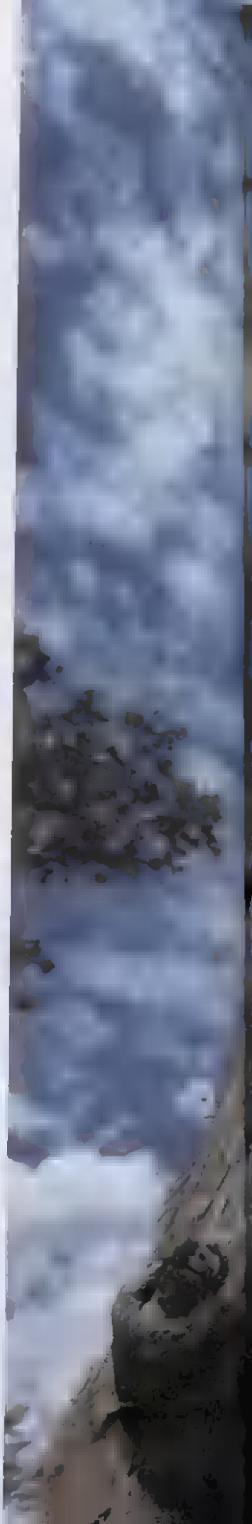
Some 8,000 years ago glaciers divided flicker populations, and two subspecies arose. Labeled for their vivid underfeathers, yellow-shafted flickers (like the birds on this page) live in eastern North America, red-shafted ones in the west. Both types mingle in a hybrid zone that runs from Texas to Alaska, where cross-breeding can produce feathers in shades of orange.





CARETAKERS

A parent stands sentry as hungry red-shafted hatchlings sound off inside a Montana aspen. Chicks can make a beelike buzzing sound that scares some predators away, but adult vigilance remains their best defense. Father flickers do most of the guarding and incubating and about half of the feeding. Maternal care, minimal as it is, dwindles over time, and some mothers even flit between two nests and two mates. For about 25 days the adults will regurgitate ants—and occasional berries in winter—for their growing young (right). Broods tend to average six or seven birds, each competing vigorously for access to the feeding hole.









UNDER SIEGE

Eviction can be swift for the unwitting. Flicker houses are often invaded by starlings, which will toss out eggs, while red squirrels (left) may lunch on flicker young before taking over the space. A hawk owl (below) preys on a foraging adult flicker, perhaps leaving a much coveted nest cavity open for birds like the bufflehead duck (above). "From an ecological point of view, flickers are a keystone species," says biologist Wiebe. "Their homebuilding helps shape forest biodiversity." □



WEB: FLIGHT OF FANCY

Get a desktop flicker image and learn more about these unusual woodpeckers at nationalgeographic.com/magazine/0408.



Rush hour,
the Beltway,
Washington, D.C.

Think gas is expensive now?

Just wait.

You've heard it before,

but this time it's for real:

We're at the beginning of

the end of
cheap

oil



MORE THAN GASOLINE

BLACK GOLD YIELDS MEDICAL IMPLANTS, FERTILIZERS, COMPUTERS



Where are the Fosters? On their lawn in Stow, Ohio, two adults and five children all disappear into a kaleidoscope of belongings made mostly from oil-based polymers. Modern life rides on such materials. "Without them, I can't think of a good way to make bike helmets," says Mark Foster, a polymer science professor at the University of Akron.



BY TIM APPENZELLER
PHOTOGRAPHS BY SARAH LEEN

Below more than a mile of ocean and three more of mud and rock, the prize is waiting. At the surface a massive drilling vessel called the *Discoverer Enterprise* strains to reach it. It's the spring of 2003, and for more than two months now the *Enterprise* has been holding steady over a spot 120 miles southeast of New Orleans in the Gulf of Mexico. The ship is driving a well toward an estimated one billion barrels of oil below the seafloor—the biggest oil field discovered in United States territory in three decades.

The 835-foot *Enterprise* shudders every few minutes as its thrusters put out a burst of power to fight the strong current. The PA system crackles, warning of small amounts of gas bubbling from the deep Earth. And in the shadow of the

23-story-tall derrick, engineers and managers gather in worried knots. "We've got an unstable hole," laments Bill Kirton, who's overseeing the project for the oil giant BP.

The drill, suspended from the *Enterprise's* derrick through a swimming-pool-size gap in the hull, has penetrated 17,000 feet below the seafloor. Instead of boring straight down, it has swerved more than a mile sideways, around a massive plume of rock salt. But now, with 2,000 feet to go, progress is stalled. Water has begun seeping into the well from the surrounding rock, and the engineers are determined to stem its spread before drilling farther. Otherwise, the trickle of water could turn into an uncontrolled surge of crude. "There's a lot of oil down there wanting to come out," says Cecil Cheshier, a drilling supervisor, after struggling all night with the unruly hole. "You can cut corners and take chances—but that could cost you a lawsuit or cause a spill into the Gulf of Mexico, and then deepwater drilling gets shut down."

The troubled well is just one of 25 that BP plans to drill in the giant field, called Thunder Horse, which sprawls over 54 square miles of



ALEXANDRA DOLMAT

seafloor. The entire project, including a floating platform half again as wide as a football field that will collect the oil from individual wells and pipe it to shore starting next year, will cost four billion dollars. But if the wells live up to expectations, each will eventually gush tens of thousands of barrels a day. "That's like a well in Saudi Arabia," says Cheshier. "We hardly get those in the U.S. anymore."

You wouldn't know it from the hulking SUVs and traffic-clogged freeways of the United States, but we're in the twilight of plentiful oil. There's no global shortage yet; far from it. The world can still produce so much crude that the current price of about \$30 for a 42-gallon barrel would plummet if the Organization of the Petroleum Exporting Countries (OPEC) did not limit production. This abundance of oil means, for now, that oil is cheap. In the United States, where gasoline taxes average 43 cents a gallon (instead of dollars, as in Europe and Japan), a gallon of gasoline can be cheaper than a bottle of water—making it too cheap for most people to bother conserving. While oil demand is up everywhere, the U.S. remains the king of consumers, slurping

Displayed with pride at the 4-Wheel Jamboree in Bloomsburg, Pennsylvania, a customized pickup (opposite) celebrates the freedom of the open road. Since 1970 the total miles traveled annually by U.S. cars and trucks has doubled, far outstripping the population growth. This traffic boom has been powered increasingly by imported oil, heightening concerns about unstable producers such as Iraq (above), Venezuela, and West Africa.

up a quarter of the world's oil—about three gallons a person every day—even though it has just 5 percent of the population.

Yet as the *Enterprise* drillers know, slaking the world's oil thirst is harder than it used to be. The old sources can't be counted on anymore. On land the lower 48 states of the U.S. are tapped out, producing less than half the oil they did at their peak in 1970. Production from the North Slope of Alaska and the North Sea of Europe, burgeoning oil regions 20 years ago, is in decline. Unrest in Venezuela and Nigeria threatens the



THE NEW STATION WAGON

7,263 POUNDS, 10 MPG, \$400 MONTHLY DIESEL BILL.



The family car is tons of fun for two young boys, who turn it into a grandstand as they just drive a pint-size Hummer near Atlanta, Georgia. "They even camp in it," says the mother. She bought the H1 for business but now drives it everywhere. "I know it's not fuel efficient, but I love knowing that anything I bump into, I win."

flow of oil. The Middle East remains the mother lode of crude, but war and instability underscore the perils of depending on that region.

And so oil companies are searching for new supplies and braving high costs, both human and economic. Making gambles like Thunder Horse and venturing into West Africa and Russia, they are still finding oil in quantities to gladden a Hummer owner's heart. But in the end the quest for more cheap oil will prove a losing game: Not just because oil consumption imposes severe costs on the environment, health, and taxpayers, but also because the world's oil addiction is hastening a day of reckoning.

Humanity's way of life is on a collision course with geology—with the stark fact that the Earth holds a finite supply of oil. The flood of crude from fields around the world will ultimately top out, then dwindle. It could be 5 years from now or 30: No one knows for sure, and geologists and economists are embroiled in debate about just when the "oil peak" will be upon us. But few doubt that it is coming. "In our lifetime," says economist Robert K. Kaufmann of Boston University, who is 46, "we will have to deal with a peak in the supply of cheap oil."

The peak will be a watershed moment, marking the change from an increasing supply of cheap oil to a dwindling supply of expensive oil. Some experts foresee dire consequences: shortages, price spikes, economic disruption, and a desperate push to wrest oil from "unconventional" sources such as tar sands, oil shale, or coal. Others think that by curbing our oil use and developing sustainable alternatives now, we can delay the peak and wean ourselves more easily when the inevitable happens. "There are many things you can do to ease the transition," says Alfred Cavallo, an energy consultant in Princeton, New Jersey. "And you can have a very nice life on a sustainable system. Of course, not everyone is going to be driving SUVs."

The stuff we pump into our gas tanks is a freak of geology, the product of a series of lucky breaks over millions of years. The first break came in a life-rich ancient sea: Sediments buried the organic material raining down onto the seafloor faster than it could decay. The next break: Eons later the seafloor sediments ended up at just the right depth—generally between 7,500 and

"IN OUR LIFETIME," SAYS ECONOMIST ROBERT KAUFMANN, "WE WILL HAVE TO DEAL WITH A PEAK IN THE SUPPLY OF CHEAP OIL." THAT PEAK WILL BE A WATERSHED MOMENT.

15,000 feet—for heat and pressure to slow-cook the organic material into oil. Then the oil collected in a "trap" of porous sandstone or limestone, and an impermeable cap of shale or salt kept it from escaping.

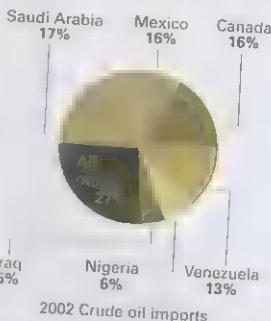
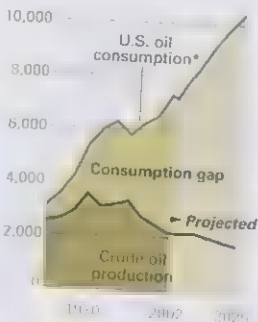
Any gap in this lucky chain of happenstance means a dry hole today. The luck held often enough that the world can now feed a daily oil habit of nearly 80 million barrels. In the U.S. about two-thirds of the oil goes to make fuel for cars, trucks, and planes. But the synthetic fabrics in our wardrobe and the plastics in just about everything we touch started out as oil too. We can also thank oil and its cousin, natural gas, for the cheap and plentiful food at the supermarket, grown with the help of hydrocarbon-based fertilizers and pesticides. As Daniel Yergin writes in his oil history *The Prize*, we live in "the Age of Hydrocarbon Man."

Around the world Hydrocarbon Man is getting thirstier. In the U.S., where oil consumption is expected to grow nearly 50 percent in 20 years, carmakers are touting horsepower as they did in the muscle-car 1960s. SUVs and minivans are displacing thrifter sedans and wagons as the standard family car. Even the tax code encourages consumption, offering people who buy the biggest SUVs for business use a deduction of up to \$100,000. Since 1988 the average gas mileage of U.S. passenger vehicles has fallen, while the world has burned up more than a third of a trillion barrels of irreplaceable oil.

THE U.S. USES MORE, PRODUCES LESS, AND RELIES ON IMPORTS

All data in millions of barrels of oil annually

* Includes refined products



The gap in the U.S. between the production of crude oil and the consumption of all the products made from it has been widening steadily since the 1970s. As a result the U.S. imports crude from dozens of countries, Saudi Arabia first among them. The U.S. will likely become more dependent on Middle East supplies in the future.

CHART: SWINGGRAPHICS SOURCE: ENERGY INFORMATION ADMINISTRATION

China, too, is learning to drink deep. A decade ago the world's most populous nation sipped oil, its streets choked with bicycles rather than motorized traffic. But last year newly prosperous professionals snapped up over two million cars—up 70 percent over 2002. China may have already leapfrogged Japan to become the world's second largest oil user. By 2025 China could be using ten million barrels a day, most of which will come from outside its own borders.

That's a predicament familiar to the U.S., where the roots of oil dependence deepened in the spring of 1971. Through 1970 the U.S. produced more than two-thirds of the oil it needed. An agency called the Texas Railroad Commission held down oil production to avoid overwhelming the market, keeping prices stable. By that spring, though, the giant, seemingly inexhaustible fields of Texas had reached their limits. The commission announced it would allow full-throttle production, but even so imports began rising—and the Texas fields just couldn't produce any faster.

That became painfully clear two years later, when Arab leaders clamped an oil embargo on the U.S. in retaliation for Washington's support of Israel in the 1973 Mideast war. Fields at home could not make up the difference. Gas lines grew and prices soared, giving most Americans their first lesson in the fragility of oil supplies.

The speed limit was dropped to 55 miles an hour to save fuel, and sales of thrifty Japanese

and European cars surged. The 1978 revolution in Iran cut off that country's oil exports and triggered a second oil shock. By 1981 crude oil prices had risen above \$70 a barrel in today's dollars, and U.S. oil consumption had dropped by nearly 15 percent from its 1978 peak. Higher prices also spurred the development of new fields outside the Persian Gulf: on Alaska's North Slope and in Mexico and the North Sea.

The new fields increased the world's oil supply, and by the inevitable logic of the market, more supply and less demand led to a price collapse. By the mid-1980s oil was selling for less than \$25 a barrel in today's dollars. OPEC's grip weakened, its share of the oil on the world market falling from 55 percent to 30 percent. And even though supply disruptions in Venezuela, Nigeria, and Iraq have pushed up prices, "the stuff is still dirt cheap," says Cavallo. It's so cheap that U.S. consumption has climbed 25 percent since the mid-1980s, to its highest level ever. Imports have surged to 54 percent of the country's oil needs. And the best hope for slowing the U.S. rise in dependence on imported oil lies far out at sea.

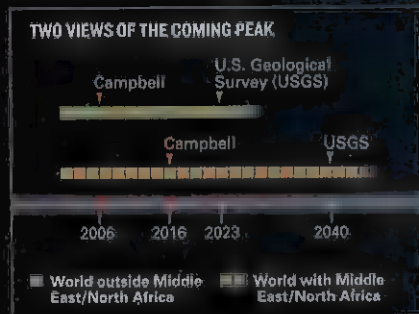
To reach the deep waters of the Gulf of Mexico, where the tireless drillers aboard the *Enterprise* are wrestling with the balky well, you board a helicopter in the coastal flatlands of Louisiana and fly south, over the small oil platforms that have colonized

(Continued on page 96)

WHERE IT IS AND HOW MUCH IS LEFT

The world isn't literally about to run out of oil. But while demand, now 80 million barrels a day, continues to grow, production of conventional (easily extracted) oil will peak eventually, with production declining after that. In the continental United States, production has already peaked—way back in 1970. There were no headlines then because the U.S. made up the difference with imported oil. When the world supply peaks, it will be far more difficult to meet demand. Unconventional sources like Canada's tar sands (right) can help, but extraction is punishing to the environment and costly: Oil prices will rise and stay high, say some experts, disrupting world economies.

TROUBLE UP AHEAD



When will the peak hit? Depends on who you ask. David Greene of Oak Ridge National Laboratory analyzed oil production rates based on a variety of supply estimates. His interpretation of data from U.K.-based Colin Campbell offers a grim picture (above): World production will most likely peak about 2016, and outside the Middle East around 2006. Using data from the U.S. Geological Survey, Greene presents a brighter picture, with world production most likely to peak around 2040. Greene notes, however, that his study has a built-in optimism, since it doesn't factor in political or environmental constraints on production. Some experts, in fact, think the peak is already here. The timing rests largely on the actions of Middle East producers and on moves to conserve and to develop unconventional sources. Either way, time is short.

NORTH AND SOUTH AMERICA



All data in millions of barrels of oil

■ World outside Middle East/North Africa ■ Middle East and North Africa

■ Annual production (2002 estimates)
■ Proven reserves (2004 estimates)

Reserves of less than one billion barrels not shown

MAP AND INSET GRAPHIC (ABOVE LEFT) BY EW INFOGRAPHICS.
SOURCES: OIL AND GAS JOURNAL AND ENERGY INFORMATION ADMINISTRATION.
(MAP); DAVID GREENE, OAK RIDGE NATIONAL LABORATORY. (INSET GRAPHIC)

EUROPE, ASIA, AND AUSTRALIA

U.K.
842

Norway
1,149

Denmark
135

Azerbaijan
111

Russia
2,703

China
1,243



AFRICA

Algeria
315

Egypt
271

India
242



MIDDLE EAST

Qatar
235

Syria
188

Iraq
735

Iran
1,252



Saudi Arabia
2,500



Kuwait
4,000

U.A.E.
684



Yemen
128

Oman
330

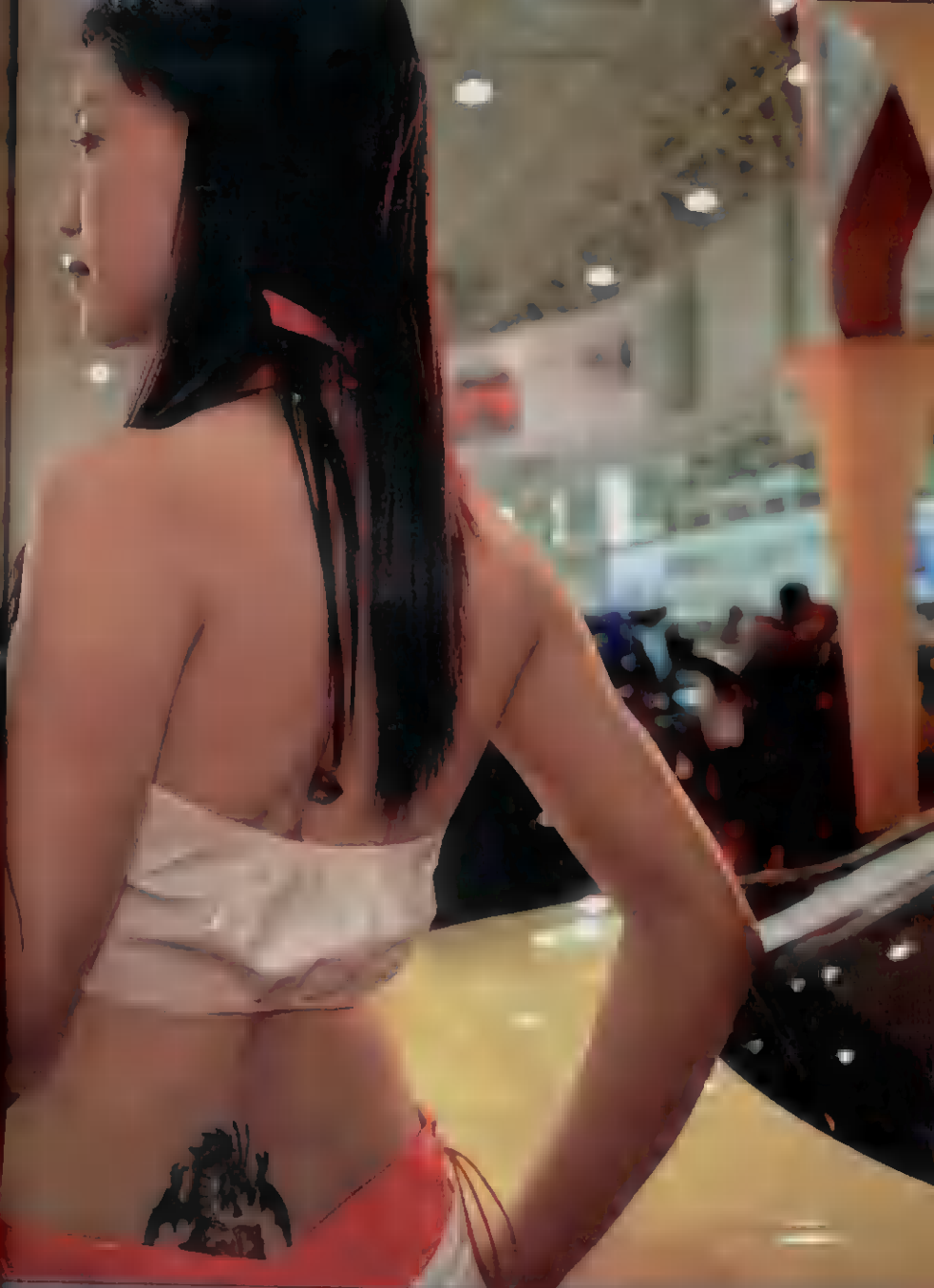


4,000

5,506



CHINA: NEXT KING OF THE ROAD?
1.3 BILLION PEOPLE, 10 MILLION CARS—AND COUNTING.



For new models—domestic and imported—drew record crowds to the 7th International Automobile Exhibition in Shenzhen last November. “People weren’t just looking,” says journalist Hu Hui. “They checked the engines, opened the doors, and sat inside.” With car ownership revving up, China has become the world’s fastest-growing oil consumer.



BUYING INTO CAPITALISM. newly prosperous professionals are clogging Chinese cities with cars. ■ 1984 the first private vehicle appeared in Beijing amid a flood of bicycles. Today a stream of vehicles surrounds the Forbidden City (above), five concentric beltways ring the growing metropolitan area, and a 15-mile commute to work can take the better part of an hour. Last September the city's first drive-through fast-food outlet opened (below). Located in a suburb popular with young executives, the business serves about 200 mobile customers



(Continued from page 89) the green shallows of the Gulf in the past 30 to 40 years. Like the fields on the U.S. mainland, they are in their twilight, their oil production slipping year by year.

The platforms thin out and vanish by the time the ocean turns the blue of deep water, an hour from shore. Soon, another platform emerges from the haze. Called Marlin, it rides the waves on stout orange pontoons, its bright gas flare streaming in the breeze. Marlin is where BP engineers first learned to tap the Gulf's deepwater riches. Discovered in 1993, the Marlin field is now in full-scale production.

Tethered to the bottom half a mile down by thick steel tendons, Marlin taps 48,000 barrels of oil a day from reservoirs two miles below the seafloor. Silvery ducts carry the crude to a complex of separator tanks. There natural gas, water, and sand are stripped out of the oil before it is pumped off the platform into a submerged pipeline, which carries it to shore.

Geologists once doubted oil could be found this far from shore. Twenty years ago, as drilling marched seaward across the shallow continental shelf, the oil-bearing sandstone layer seemed to be petering out. Scientists concluded that the sand deposited tens of millions of years ago by great rivers had not spread all the way out on the shelf. But they were mistaken. The sand—and oil—was there all right.

The sand had spilled off the edge of the shelf and down the steep continental slope to the deep-ocean floor. There it had pooled in apron-like deposits that turned into porous rock—perfect for capturing oil oozing from still deeper rock layers. In the 1990s, as hints of these deposits began showing up in seismic data, the vanguard of oil production stepped off the continental shelf, into waters thousands of feet deep. Now giant new fields, the biggest of them Thunder Horse, beckon at 6,000 feet and more. At still greater depths approaching 10,000 feet, says geophysicist Roger Anderson of Columbia University, “there have been a whole series of finds,” although they have yet to be exploited.

All in all, oil experts estimate that the deep waters of the Gulf of Mexico will yield more than 25 billion barrels of oil. That's twice as much as in Alaska's giant Prudhoe Bay field, and far more than in any untapped U.S. prospect, including the controversial Arctic National Wildlife Refuge. “There's a major consensus that there's more oil

“PEOPLE SHOULD BE DOING SOMETHING NOW TO REDUCE OIL DEPENDENCE,” SAYS PHYSICIST ALFRED CAVALLO, “AND NOT WAITING FOR MOTHER NATURE TO SLAP THEM IN THE FACE.”

there than you'd ever find in ANWR,” says Anderson. With the boost from deepwater wells, offshore oil should increase from a third of U.S. oil production now to more than 40 percent by 2008, before tapering off. But it will still barely ease the American thirst for oil.

On the other side of the Atlantic, just off the coast of Cameroon, in West Africa, a giant pipeline terminal is helping quench that thirst. Every few days a tanker departs from the terminal with a belly full of oil piped 665 miles through savanna and rain forest from the billion-barrel Doba fields in Chad. The oil began flowing in July 2003, much of it bound for the United States. At 3.7 billion dollars, the project is the biggest private-sector investment in sub-Saharan Africa—a measure of U.S. interest in the 30 billion to 50 billion barrels of oil trapped in and near the Gulf of Guinea. A swelling river of crude from Chad, Nigeria, Angola, and other African countries now makes up 15 percent of U.S. imports and is expected to rise.

The Chad-Cameroon pipeline is more than another assurance that U.S. gas stations won't run short. It's also an effort by the World Bank and an industry consortium led by Exxon-Mobil to reverse the mounting human costs of oil development in Africa. So far, says Terry Lynn Karl, a Stanford University political scientist, the track record is “about as bleak as you can get.”

By fueling inflation and dreams of quick wealth, she says, oil revenue has withered Africa's oil economies. In Nigeria the proportion of the population living in severe poverty has more than doubled, to 66 percent, after three decades of oil production. Oil revenues have vanished from national treasuries and into the pockets of corrupt officials in staggering amounts—over four billion dollars since 1997 in Angola, for example. “Oil has had a tendency to erode the democratic institutions that did exist,” says Ian Gary of the Catholic Relief Services, who co-authored a study of African oil development with Karl. And oil money has often fed the region's many civil wars.

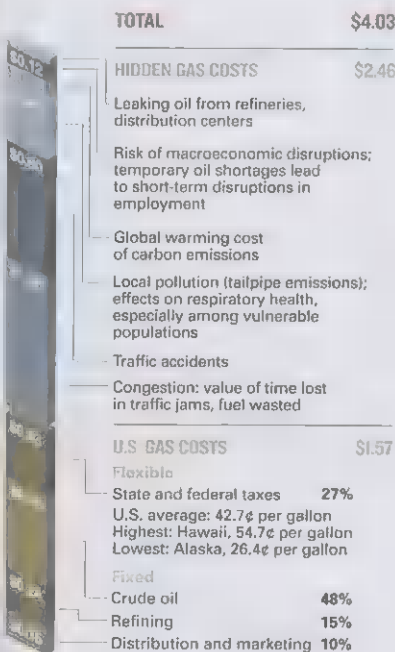
Eager to avoid such problems in Chad, ExxonMobil enlisted the World Bank to ensure that the country's government spends its oil

windfalls on its people. The bank insisted that Chad set up an independent committee to manage its new riches—109 million dollars or more this year—reserving most of it for infrastructure, education, and health. The bank also monitored the pipeline construction and arranged compensation for farmers along the route.

But to Karl the arrangement has “loopholes you can drive a supertanker through,” and Chad's government got off to a spectacularly bad start when it spent 4.5 million dollars—of a 25-million-dollar initial bonus from the oil companies—on weapons. Yet Columbia University law professor Peter Rosenblum believes the agreement is an important step. “As much as there's foreboding and fear about what's going to happen, there's also a recognition that this has put into place meaningful ground rules.”

THE REAL COST OF GASOLINE

What U.S. drivers pay to fill the tank varies slightly by location and reflects the costs of turning crude into the gasoline that is sold at more than 130,000 outlets. External costs are harder to nail down; estimates vary widely.



In Africa, oil's corrosive effects are metaphorical. In Kazakhstan, another frontier in the oil scramble, the crude itself is literally corrosive. The Central Asian land east of the Caspian Sea boasts the biggest single discovery in 30 years: a vast geologic trap extending beneath the Caspian, called the Kashagan field, that could yield seven billion to thirteen billion barrels as it's developed. But it won't be easy. Its oil is under high pressure and laced with poisonous hydrogen sulfide, which requires special equipment and handling. And the field lies in the northern Caspian, a stronghold of the endangered beluga sturgeon, in waters too shallow for ordinary ships and oil platforms.

In the 1990s the first glimpse of fields like Kashagan spurred talk that the Caspian might be a new Middle East, with reserves of hundreds of billions of barrels. But the promising geologic structures did not always hold oil. More sober assessments now put the Caspian's promise at 17 billion to 33 billion barrels.

The real challenge to the Middle East's oil dominance comes from elsewhere in the old Soviet Union: the boggy, cold forest of western Siberia. Once the bulwark of the Soviet oil industry, Siberia declined in the early 1990s as its wells and infrastructure fell into disrepair. Many analysts believed Siberia's oil was played out. Now it's making a comeback.

Russia passed Saudi Arabia in 2003 as the world's biggest producer. And, says Matt Sagers, ■ Russia expert at (Continued on page 102)

CHART BY SW/FIGUREPHICS. JANUARY 2004 AVERAGES. SOURCES: ENERGY INFORMATION ADMINISTRATION AND AMERICAN PETROLEUM INSTITUTE. U.S. GAS COSTS: IAN PARRY (HIDDEN GAS COSTS)



THE PRICE OF STEAK

A POUND OF BEEF TAKES THREE-QUARTERS OF A GALLON OF OIL TO PRODUCE



weighing in at 1,200 pounds, Wayne Wilson's stainless steel Greenwood Rebel 63447, his auction at a county fair in Maryland. Raising this year has taken an agricultural investment equal to 203 gallons of oil—represented here by the red drums. That includes everything from fertilizers to pesticides to the diesel that runs combines on the farm.



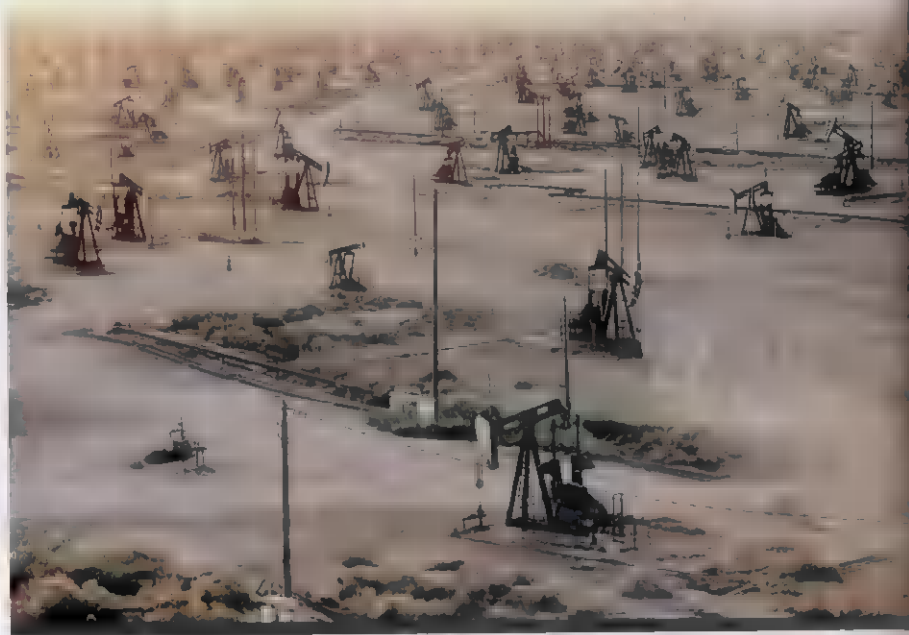
SERIOUS CONCERNS begin to mount the moment oil gushes from a well. With security in mind, the U.S. Navy and Coast Guard join forces to patrol the Houston Ship Channel (above). Traffic here includes tankers delivering crude to the world's second largest petrochemical complex, the source of 15 percent of the gasoline used in the United States. Residents of Port Arthur, Texas (above right), believe the emissions from nearby oil refineries cause health problems. When the air smells like sulfur, signaling vented fumes, they capture a sample in





a vacuum bucket for testing. "The refineries say things are getting better," says Hilton Kelley, at left, "but the numbers don't reflect it." By-products of the U.S. car culture (below) rise from a private dump that the state of Ohio is cleaning up. Until recently the site held 20 million tires, each manufactured with seven gallons of oil. At a California rest stop (below left) truckers save fuel by connecting to IdleAire's yellow tubes for comforts such as AC, phone, and Internet access. Without the hookup they'd have to leave their engines running to get power.





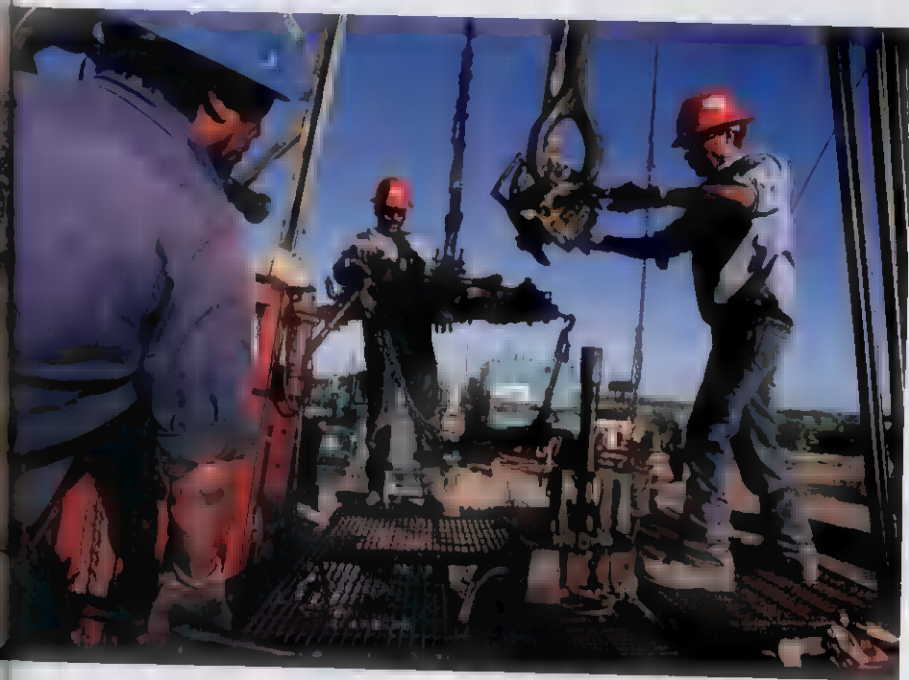
Cambridge Energy Research Associates, "for Russia it's still up, up, and away." That's because the rough-and-tumble private companies that grabbed the Soviet fields at fire-sale prices in the early 1990s have gotten serious about modernizing them. Enlisting Western specialists, the companies resurveyed the fields with up-to-date seismic technology to determine where the oil was hiding and how best to get it out. They shut down unpromising wells and coaxed more out of others by hydraulic fracturing: driving high-pressure fluids down the wells to break up the rock and open new escape routes for the crude. "We went in and developed the fields the way ExxonMobil or ChevronTexaco would have done and are getting [production] increases of 20 percent a year," says Ray Leonard, an American oilman and a vice president of Yukos, one of Russia's two largest oil companies.

Russia is pumping nearly nine million barrels a day and exporting about two-thirds of it. Production would be even higher if Russia only had enough pipelines to get the oil to its borders. Says Eugene Khartukov, director of the Moscow-based Center for Petroleum Business

Studies: "If the export routes are opened, the oil will fly like a cork from a bottle of ex-Soviet champagne."

But struggles between the oil companies and Russia's government, which owns the pipelines, have slowed the construction of new routes to an ice-free port in the west and to China and Japan, eager customers. And the jailing for alleged fraud and tax evasion of former Yukos boss Mikhail Khodorkovsky, a billionaire with political ambitions, has scared off foreign investors who could bankroll further upgrading of the fields. Even so, Russia's output is drawing uneasy glances from OPEC. A surge of Russian oil could undercut the cartel's effort to adjust its production to hold world oil prices between \$22 and \$28 a barrel.

Leonard puts Russian reserves at around 100 billion barrels. Other experts say the companies haven't explored enough to know. Either way, even Russia has its limits, as Leonard acknowledges. He thinks Russia's oil output will crest in 10 to 15 years, putting OPEC firmly in control of prices again. "Around the middle of the next decade, the price of oil is going to go up



and stay up," he says. If it does, an unusual kind of oil that exists far from the Middle East will become more alluring.

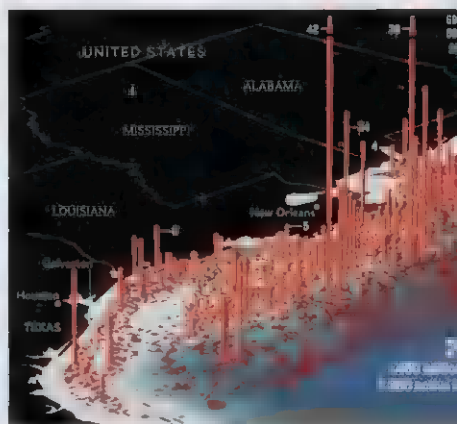
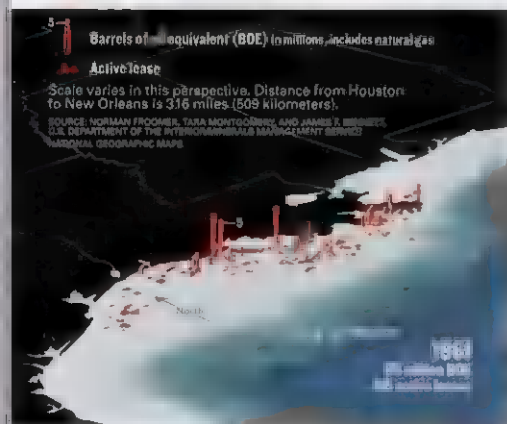
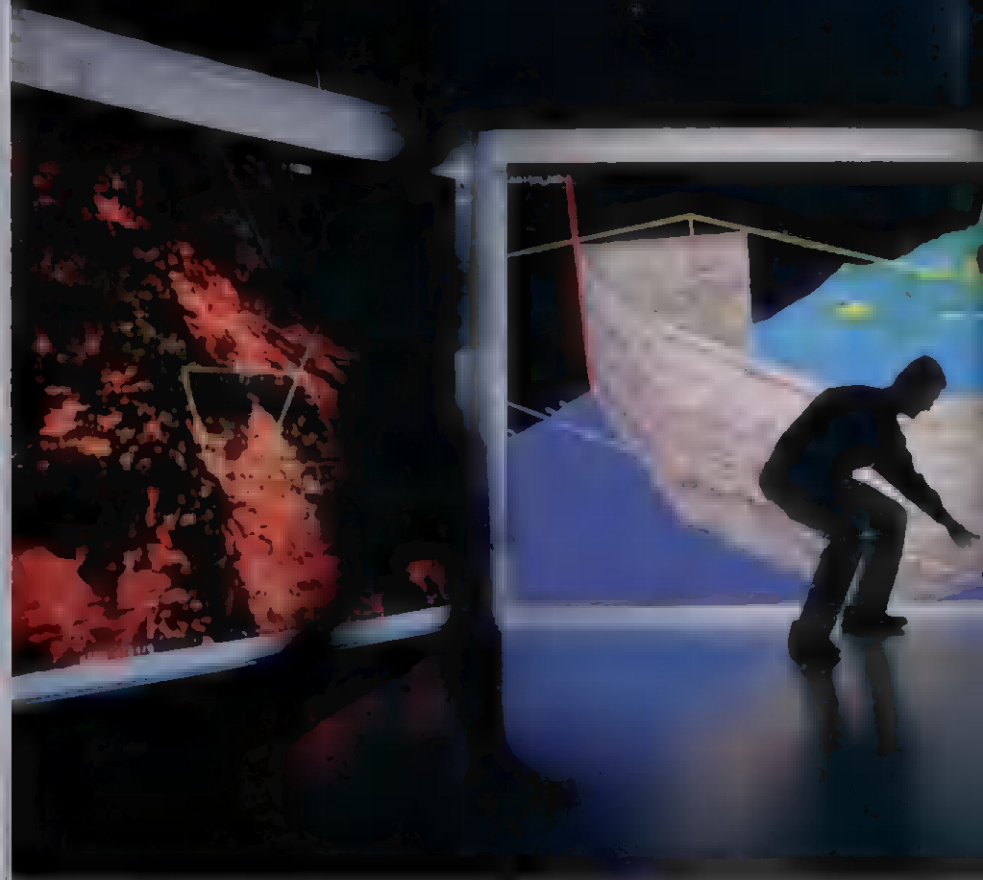
You can get a glimpse of it just north of Fort McMurray, a former fur-trading outpost in the Canadian province of Alberta. Just where the highway crosses the Athabasca River, veins of black, tarry sand streak the riverbanks. On a hot day tar sand is sticky and smells like fresh asphalt—the smell of money the locals call it. No wonder they're smug. The tar-sand deposits here and elsewhere in Alberta hold the equivalent of more than 1.6 trillion barrels of oil—an amount that may exceed the world's remaining reserves of ordinary crude. But this is no ordinary crude. In fact, it's a residue created when conventional oil escaped from its birthplace deep in the Earth's crust and was degraded into tar by groundwater and bacteria.

Most of the tar sand lies too deep or in deposits too sparse to be exploited. But oil-sand companies got a boost in the 1990s as technology improved and Canada cut the first few years

Discovered in 1911, California's South Belridge field (opposite) has produced more than a billion barrels of oil. Tapped by 10,200 wells, it may have several decades of life left—but with a declining output. In Texas a crew plugs a well abandoned by the owner when its flow slackened to a trickle. The state spends more than \$1 million dollars a year plugging 1,500 such wells to keep oil, salt water, and other contaminants from seeping into aquifers.

of the royalties that companies were required to pay. The Alberta government reckons that 174 billion barrels could now be tapped economically. Last year the U.S. Department of Energy agreed and included that number in Canada's proven reserves. The move catapulted Canada to second place in the ranking of oil-rich states, right behind Saudi Arabia—and ahead of Iraq, Iran, and Kuwait.

But standing at the edge of a 200-foot-deep pit where giant electric- and diesel-powered shovels devour beds of oil sand, Shell Canada Senior





PLUNGING INTO DEEP WATER

Like a surgeon's CT scan, a three-dimensional seismic image reveals rock formations that may hold oil. At Anadarko's headquarters near Houston, Jim Emme, vice president for exploration (above, at right), and Istvan Barany, a geophysicist, ponder the possibilities for one of the company's active leases under more than 8,000 feet of water in the Gulf of Mexico. Four decades ago ■ wells operated close to shore in relatively shallow water (far left). Since then advances in exploration and production have enabled wells to reach reserves on the deeper continental shelf (left)—and beyond. "If you had asked me in 1961," says Emme, "I'd have said that what we're doing now was impossible."

Vice President Neil Camarta acknowledges that there's a big difference between the oil-sand riches and free-flowing crude. "It's not like the oil in Saudi Arabia. You see all the work we have to do; it doesn't just jump out of the ground." Shell's is one of three big operations that together wring more than 600,000 barrels of oil a day from the Athabasca sands. Every step of the way takes brute force.

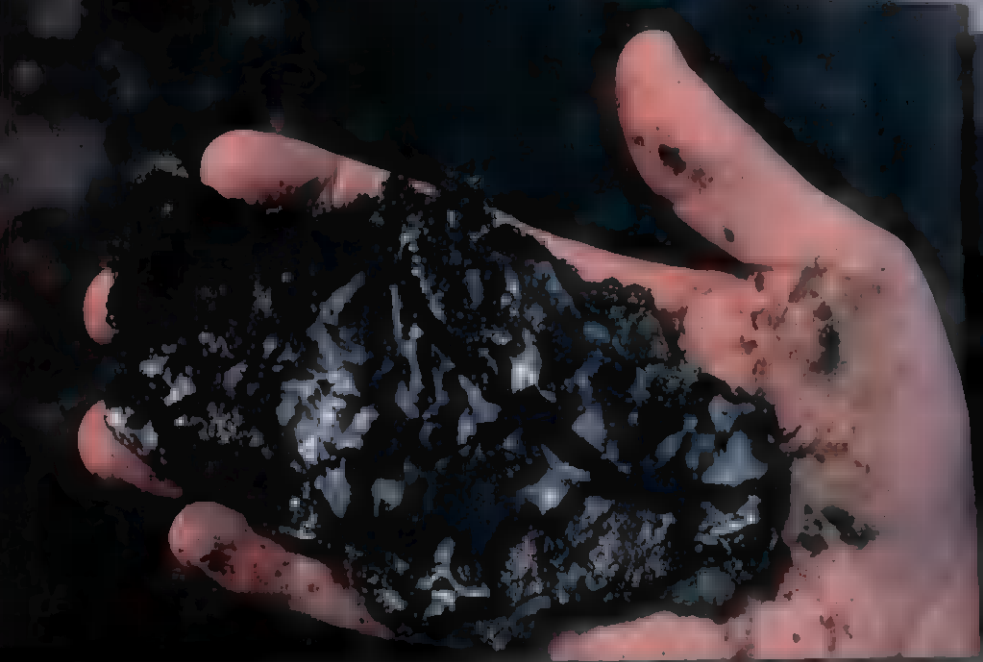
The sand has to be strip-mined, two tons of it for each barrel of oil. Dump trucks the size of mini-mansions haul 400 tons in a single load, in beds heated during the subarctic winters so the sand doesn't freeze into a giant blob. Next to the mine, the sand goes into the equivalent of giant washing machines, where torrents of warm water and solvent rinse out the tar, or bitumen, leaving wet sand that is dumped in tailing ponds.

Even then the bitumen is not ready to be piped off to a refinery like ordinary crude. To turn it back into crude oil, the operations either cook it in cokers, where temperatures of 900°F break up the giant tar molecules, or heat it to lower temperatures and churn it with hydrogen gas and a catalyst. The result is a clean, low-sulfur crude—"beautiful stuff," says Camarta.

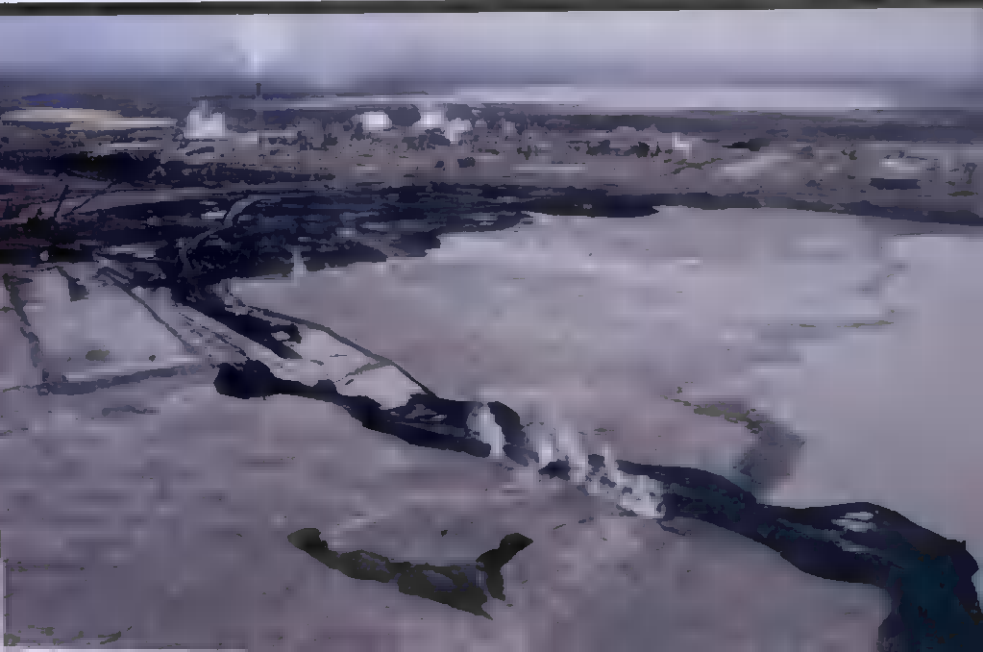
But producing it is not so pretty, he acknowledges. "This really is a big, big project," Camarta says of Shell's four-billion-dollar mine and plant, which opened last year. "It has a big footprint too, and we don't hide that—a big environmental and a big social imprint."

Other oil-sand operations have left the land north of Fort McMurray pocked with mines and lakes of sludgy gray tailings. So far less than 20 percent of the disturbed land has been restored to grassland and forest. Dust, diesel exhaust, and sulfurous fumes pollute the air. It takes three barrels of water to extract each barrel of bitumen, and although the plants are careful to recycle water, they still draw heavily on the Athabasca River. Heating all that water takes vast amounts of natural gas. Worried about Canada's dwindling natural gas supplies, Alberta has even considered someday building a nuclear reactor smack in the tar-sands region to supply power and steam.

The local First Nations people—Canada's Native Americans—mourn the loss of once pristine land. In the village of Fort McKay seven miles from Shell's mine, the company paid to



SIGN OF BIG PROSPECTS. tar (above) oozes from sand along the Athabasca River in northeastern Alberta, Canada. Formed millions of years ago as oil leaked from reservoirs, the tar, or bitumen, permeates more than 15,000 square miles. Improved techniques for washing it from the sand and converting it back to oil make the sands profitable to exploit, although the process consumes huge amounts of natural gas and water. With deposits amounting to more than 1.6 trillion barrels of oil, mining companies are digging in for the long haul. Around the





clock an army of enormous shovels (below) gouges sand from pits until hitting bedrock at about 250 feet. Filled with sand—it takes two tons to make each barrel of oil—one truck after another heads to the processing facilities (above). Syncrude, the largest of the three major operators here, obtains roughly 240,000 barrels of oil from the sand every day. Already finished with one area (below left), Syncrude has begun to refill it with tailings—the original sand, washed light gray—and plans to replant native trees and grasses as soon as the fill settles.



build a community center on the poplar-clad banks of the Athabasca. Seated by a soaring fireplace bearing a Shell plaque, Chief Jim Boucher, president of the Athabasca Tribal Council, acknowledges that development has brought jobs and money. But the chief, who grew up trapping mink, muskrat, and beaver in intact forest, says: "In people's minds, what's going on is too much. We're losing too much of our land. The amount of destruction, especially in the minds of the elders, is horrendous."

Unless oil prices collapse, the destruction is likely to continue. With tar-sand production costs down to about ten dollars a barrel, the operations expect to make a handsome profit. Existing mines are expanding, and more companies are jumping in. Some are starting to exploit tar sands too deep to be mined, by forcing high-pressure steam down wells to melt out the bitumen. Production could reach two million barrels a day in a decade, according to the Alberta government.

That may be a comfort when the other up-and-coming oil fields of today start to dwindle, from the Gulf of Mexico to Russia. But the tar sands won't be enough to stave off new dependence on the volatile Middle East. The U.S. government's Energy Information Administration projects that in 20 years, the Persian Gulf will supply between one-half and two-thirds of the oil on the world market—the same percentage as before the 1973 embargo. Fifty years later, in other words, the Middle East will have regained all its old power over oil—and the U.S. government knows it. Whether or not Washington's war in Iraq was directly motivated by oil, American planners clearly hoped it would lay the groundwork for a stable, democratic Middle East—which, among other benefits, would in Washington's view put the world's oil supply in more trustworthy hands.

Yet the real threat to the world economy 20 years from now may not be the policies of the Middle East. It may be a global shortage of conventional oil. These days a raging debate divides oil experts, with prophets of imminent shortage pitted against believers in at least a couple more decades of abundance. Pessimists note that oil prospectors had their best luck in the early 1960s, and that discoveries have slowed since

then. They conclude that little conventional oil is left to be found and that the oil peak could be upon us by 2010. Optimists call that a naive extrapolation, which overlooks the economic and political factors that drive the search for oil. "People who are predicting an imminent peak are simply wrong," says Boston University's Kaufmann.

The argument ultimately depends on how much oil is left in the world's biggest wellspring of crude, the Middle East. With nearly two-thirds of proven conventional reserves, Middle Eastern lands will be the supply of last resort as oil production declines elsewhere. "We take it for granted that they'll come forth with whatever volume of oil is needed to balance supply and demand," says Robert Ebel, head of the energy program at the Center for Strategic and International Studies, a Washington think tank.

Maybe not for long, says Matthew Simmons, president of the Houston energy-investment advisory bank Simmons and Company. He notes that Saudi Arabia, "the one country that we always assumed had fabulous reserves," hasn't found a big new field for decades. And in Saudi technical reports he sees hints of trouble: When water starts coming up a well, its productive life is over—and that's starting to happen in Saudi fields. If he's right, even the Middle East may fall short of growing demand sooner than expected.

On the optimistic side, the United States Geological Survey (USGS) concluded in a 2000 study that there's at least 50 percent more oil left than the pessimists believe, much of it in the Middle East. New technologies will wring additional supplies from existing fields, the USGS predicts, and vast new reserves remain to be found. Many economists agree, saying discoveries have fallen off simply because countries awash in oil like Iraq, Iran, and Saudi Arabia have had no incentive to drill for more. "If I'm an OPEC producer, with lots of spare capacity, why would I waste money looking for more reserves?" asks Kaufmann.

But in the end, "you're talking about a few years one way or another," says Cavallo, the Princeton consultant. Thomas Ahlbrandt, the geologist who led the USGS study, says that even the larger reserves he envisions can't sustain the world's growing thirst for oil indefinitely. "Oil and gas are limited," he says flatly. "My personal feeling is,



Leading the way to a more fuel-efficient future, the sheriff's office in Martin County, Florida, added hybrid cars to its fleet, though not as pursuit vehicles, in 2001—a first for law enforcement agencies in the United States. Civil Deputy Debbie Herrschaft, at right, drives a Prius. "The only difference I notice is at the gas pump," she says. "I only fill up about once a month."

we have a concern in the next couple of decades."

Either way, the crude won't suddenly dry up: Old oil fields don't die, they slowly fade away. But the world will face shortages more lasting than any 1970s oil shock—and some stark choices. Should we increase production from the Canadian tar sands and similar "heavy oil" deposits in Venezuela? Try to exploit the American West's vast deposits of oil shale and other organic-rich rock that yields oil when roasted? Both options carry heavy environmental costs. Or should we pin our hopes on finding new supplies of natural gas, extracting fuel from plant material, or building solar, wind, or nuclear plants to make hydrogen for fuel-cell vehicles? There are no easy options, and all will take time to explore.

Aboard the *Enterprise* drill ship in the deep Gulf, engineers and roughnecks are doing their best to postpone the day of reckoning. By the summer of 2003 they had brought the well under


control and finished it, 15 million dollars over budget and a month behind schedule. "We did fight that well for a little while," says BP's Kirton wryly. Now they've moved on to other holes, laboring on a drilling floor slick with fluids while the ship battles the current and the bit gnaws through salt, shale, and sandstone toward the geologic legacy that fuels our way of life.

But ■ least some of the ingenuity and toil that goes into getting oil needs to go toward limiting our thirst for it. "People should be doing something now to reduce oil dependence and not waiting for Mother Nature to slap them in the face," says Cavallo.

With every visit to the gas pump, after all, the end of cheap oil draws closer. □

WHAT'S YOUR MPG? Should tax deductions for hybrid cars ■ increased? Should the deductions for SUVs be reduced? Sound off in our Forum and get a listing of related websites ■ nationalgeographic.com/magazine/0406.

Home far Away



02860

Born in Cape Verde, Africa, but living an ocean away, Ildebranda Oliveira tends bobbins for \$7.50 an hour at Stretch Products in Pawtucket. She misses her homeland's weather and food, but not its poverty: "Over there there's no jobs. Over here I work and make money." Plentiful employment and affordable housing—triple-deckers (far right) can house entire extended families—have lured Cape Verdeans to Pawtucket, the latest wave of immigrants to this old mill town. Born in the U.S., two-year-old Jade Gomes naps, sure to one day hear tales of the island nation her family left behind.

BY KAREN E. LANGE NATIONAL GEOGRAPHIC WRITER
PHOTOGRAPHS BY JACQUELINE MIA FOSTER







02860

POPULATION:

46,400

CAPE VERDEAN POP:

more than 7,000

MANUFACTURERS: 130**AVERAGE RENTS:** \$600

to \$1,000 a month

CLAIM TO FAME: Birth-

place of America's industrial revolution (1793)

LATEST MILL OCCUPANTS:

Artist lofts and galleries

A few blocks from the river of traffic on I-95 that cuts Pawtucket in two, from the fast-food restaurants, gas stations, and motel that light otherwise dark streets, lies a snug bright club called Cantinho, where Cape Verdeans retreat from the rush and regrets of their adopted home. On a Saturday night, well-dressed men and women, their skin ranging from dark chocolate to coffee flooded with cream, drink amber-colored *grogue*. The room buzzes in Kriolu, a blend of Portuguese and West African languages that slaves arriving from the 15th to the 19th centuries created in Cape Verde, 10 islands some 400 miles off the coast of Senegal. On the walls hang pictures of a white sand beach, a packet boat that carried Cape Verdeans fleeing drought and poverty to New England early in the 20th century, and Amílcar Cabral, the revolutionary who fought for the country's independence from Portugal in 1975.

One of Cantinho's owners, Jack Galvão, left the Cape Verdean island of Brava in 1979 at 17, part of an exodus triggered by fear that the islands' economy would be driven to collapse by a post-independence swerve to the left. He arrived in Rhode Island with three years of high school English, took a factory job, and worked his way through college. Now a successful accountant and real estate agent, he still yearns for the land of his birth. "In Cape Verde you don't buy yourself a drink," says Galvão, "your friend buys you a drink." As if on cue, he asks the bartender to pour some *grogue* for a man across the room.

A guitarist begins to play, backed by a bass and a keyboard, and the club fills with the music of the islands and their far-flung diaspora—languid, dreamy songs called *morna* and faster counterparts called *koladera*. Soon one of Galvão's friends, João Alfredo, takes the microphone.

Walking out between the tables, he fixes his gaze on a seated woman, then gestures with an upraised palm to another. "We don't have anything in the world bigger than love," he croons. "Love is bigger than the sea and sky."

The crowd applauds and joins in: "Tell me, my love, which way is the sky? The sky is in your breasts and in your black eyes."

The Depina family (above) packs a drum with Nikes, Stove Top Stuffing, diapers—you name it—to ship to a brother in Cape Verde. Teenagers in Payne Park (below) may play like other American teens, but when they talk to each other it's in Kriolu, the language of the islands.



PAWTUCKET, RHODE ISLAND

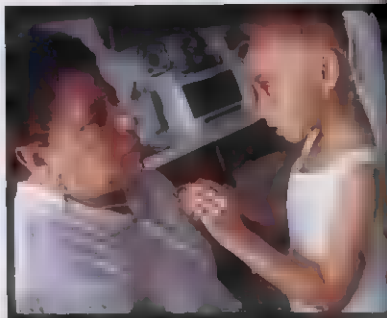
A simple love song, perhaps, but it's part of a larger, more complicated romance: the bittersweet nostalgia of self-imposed exile. *Sodadi*, Cape Verdeans call it—longing. Or *triste alegria*—sad happiness. Economic necessity may have driven them from their home and keeps them from moving back, but their hearts remain in the islands. "It's wanting to stay but having to go," Galvão says. "It's sad because you're leaving, but happy because you're going to opportunity."

Cape Verdeans have been coming to Pawtucket in increasing numbers since U.S. immigration quotas were raised in the 1960s, drawn by manufacturing jobs and affordable rents. Most of Pawtucket's Cape Verdeans work in factories housed in 19th-century textile mills, live nearby in clapboard homes erected for earlier generations of immigrants, and grow flower and vegetable gardens as an echo of the family plots they left behind. If they can afford the airfare, they return home in the summer. If they can't, they return through music you hear everywhere in the neighborhood: The melody of a live guitar, or tunes on a Cape Verdean radio program, drifting out of a kitchen window; drumbeats as members of the Sons of Brava social club grind corn for a festival honoring São João Baptista, Brava's patron saint; CDs of songs recorded locally, then sold worldwide.

Pulonga'l Bitá and his band, Amigos para Sempre, lounge on an old sofa in a cramped basement studio after recording traditional African-influenced roots music called *batuque* and *funana*. It's the music of poor country people, so unvarnished it was forbidden in pre-independence Cape Verde. "If you played that in the city, the Portuguese was going to put you in jail," says accordionist Zito'l Code, who performs to the metallic beat of a *ferinhu*—an iron bar tapped and scraped with a butter knife.

Bitá, who looks a little like a hip-hop star—with his earrings, backward baseball cap, and upside down sunglasses—describes *batuque* on his home island of São Tiago. "The people go like that," he says, alternately slapping one thigh and then the other to produce a muffled snap that resembles the canter of a far-off horse. "And they dance all night." Bitá has turned *batuque* to contemporary themes in a series of songs about a Cape Verdean immigrant who is rejected by a girl because of

Faith and family unite in a first Communion celebration for seven-year-old Alicia Almeida. She dresses with her mother, then touches the gold necklace of her grandmother, who taught her Kriolu and gave her the traditional "black ball" charm that many Cape Verdeans believe wards off evil. Solemn in her Catholic procession, Alicia later skips home to feast on *kanja*, a favored island soup.





One local song hit the top of the Cape Verdean charts, but the singer still earns his living as a landscaper.

his poor English. One hit the top of the Cape Verdean charts, but Bitá still hasn't given up his day job as a landscaper.

Late one afternoon, while Bitá is still at work, the mother of his children, Regina Garner, slices green bananas and manioc in their two-story walk-up for the family's dinner of fish stew. She isn't hungry herself, having eaten at McDonald's on the way home. Garner arrived in Pawtucket in 1989 with \$20 in her pocket. The same day, she found work in a factory and a \$300-a-month apartment. Slowly she built a life, one of happiness tinged with sorrow. *Triste alegria*. "I miss people, especially my father. . . . But over there you can't take care of your kids the way you want." Garner earns \$15 an hour as a restaurant cook, a job that has scarred her forearms with burns.

Out in the driveway the couple's sons, ten-year-old Wilson and three-year-old Harrison, are playing basketball. In the dining room Garner's cousin Maria Lourdes Silva, visiting from Cape Verde, sits with a new baby boy, watching a music video: Bitá and the band playing *batuque* in downtown Providence surrounded by women shaking their hips to the beat. Silva's baby is 12 days old, born just after she arrived in Pawtucket. She timed the trip so he would be an American citizen. Inspired by a place mat of U.S. presidents (and his and his brother's own names), Wilson named his baby cousin Kennedy. The infant begins to fuss, and Silva settles him into her arm and taps out *batuque* on his foot: the music of memory, the music of survival, the music of faraway home. □



Pulonga'l Bitá (playing accordion) jams with his band; older immigrants dance to a slower beat. Cape Verdeans may leave the islands, but the islands don't leave them, lingering in music and memory.

WEBSITE EXCLUSIVE Find more 02860 images and listen to the lively Cape Verdean music of the band *Amigos para Sempre* at nationalgeographic.com/magazine/0406. Then tell us why we should cover YOUR FAVORITE ZIP CODE at nationalgeographic.com/magazine/zipcode/0406.

Final Edit



SHIITES OF IRAQ

Vantage Point

Seen from above, the courtyard of Imam Ali shrine in Najaf, Iraq, unfolds in a kaleidoscopic field of rugs as Shiite worshippers arrive for prayer. "I love this image because of all the layers and patterns—it's not what Western eyes are used to seeing in a place of worship," says design editor Elaine Bradley.

As the layout of the article took shape, however, it became clear that the picture was too distant—physically and emotionally—for the tone of our article. The editors felt they needed to give readers an up-close look at who the Shiites really are. They wanted to stress the more unexpected diversity and secularism of the people rather than focusing exclusively on religious fervor. "We ended up emphasizing more dynamic images that showed life down at the street level," says Bradley.

WEBSITE EXCLUSIVE

Cut it or keep it? Find out more about what tipped the balance for this photo and send it as an electronic greeting card in Final Edit at nationalgeographic.com/magazine/0406.

ON ASSI

ON THE ROAD, IN THE FIELD

SHIITES

In the Danger Zone

How to shoot in postwar Iraq without getting shot

Journalists working in foreign countries often hire a fixer—someone who speaks the local language and can navigate unfamiliar culture and customs. While photographer **Matt Moyer** (right) was shooting in Iraq, his fixer (below, with extended family members) added one more duty to his job description:

GEOGRAPHIC to go back, spending six months in the country.

As a photojournalist, Matt needed to be where the action was, which often meant finding himself in the middle of an agitated mob. "When Saddam was caught, there were celebrations in the streets. It was probably the time I felt most uneasy."

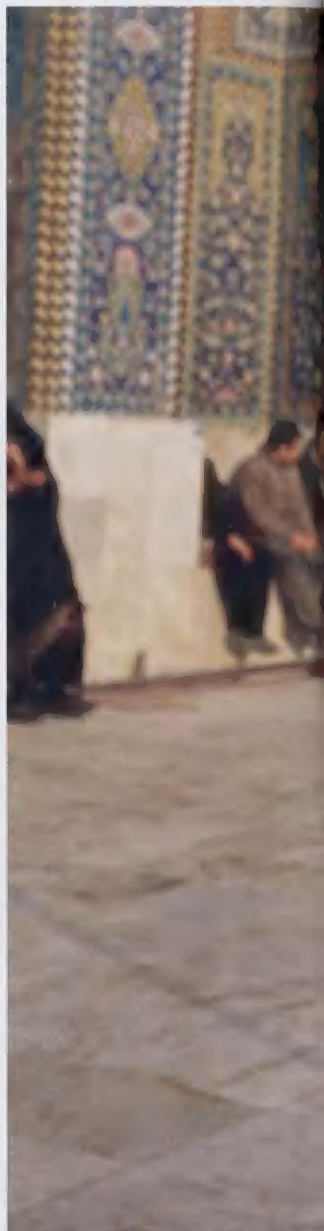


MATT MOYER

Keep Matt from getting killed.

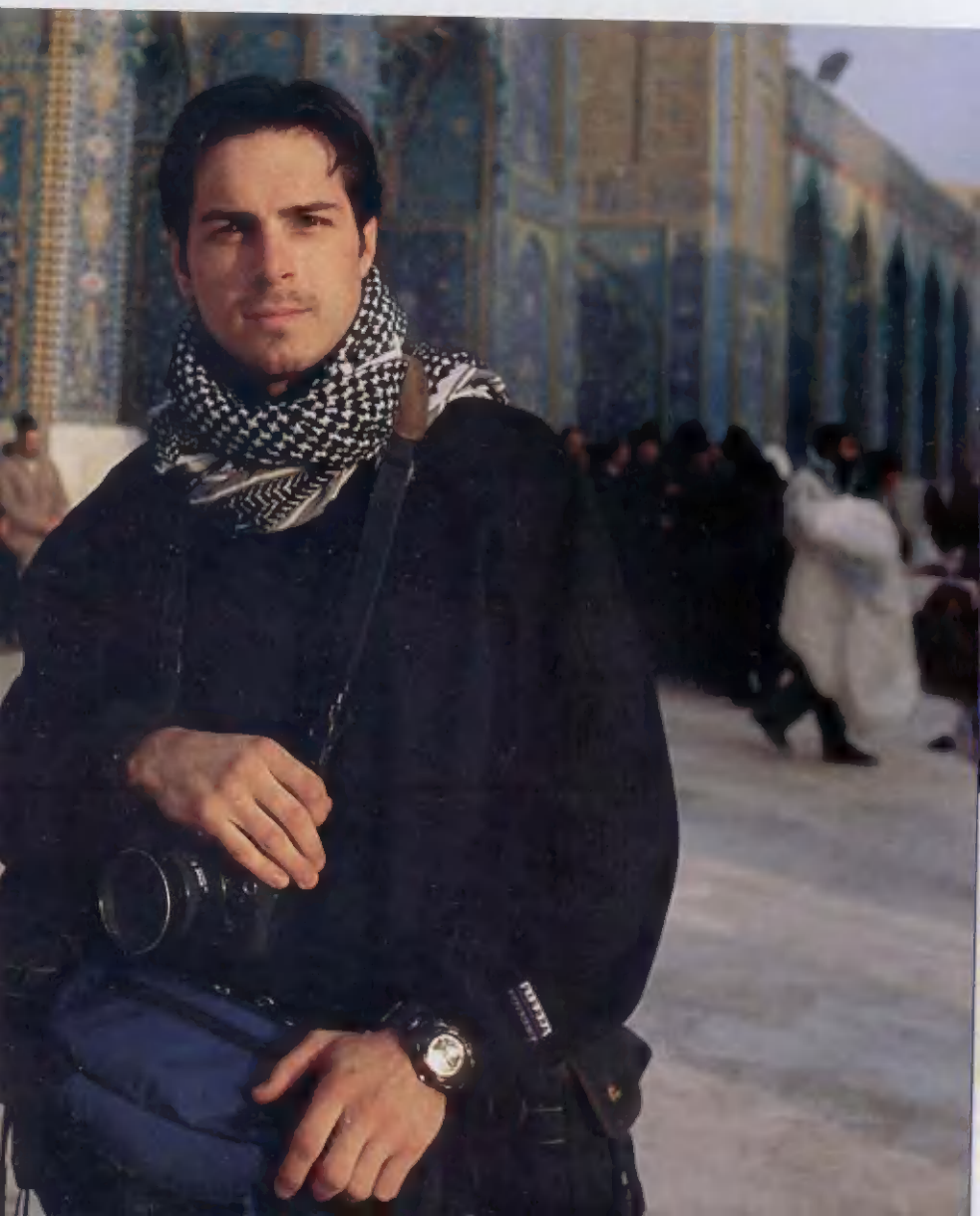
"Things get a little crazy there," says Matt, who speaks some Arabic but hadn't spent any time in Iraq before. He arrived in Basra—where "crazy" can mean happening upon a crowd throwing stones at prostitutes—shortly after Saddam Hussein's regime fell. He financed that first trip on his own ("I even bought my own body armor," he says) before being hired by NATIONAL

Matt's fixer—who requested that his name not be used because Iraqis working with foreigners have become targets—frequently put himself between Matt and danger. He even slept by the door when they traveled together in bandit territory. Says Matt, "When you're looking through the lens, you can't see what's going on around you. It's important to have somebody literally watch your back."



GNMENT

O V E R I N G T H E W O R L D





DALE DONO

CHEAP OIL

When It's Oil in the Family

She wanted to show just how many petroleum-based products a typical American family might own. But first photographer **Sarah Leen**

(above, behind yellow ball) had to find a typical family that would let her sort through all their possessions and display what she found as a giant still life on their

front lawn (see pages 82-83).

The Foster family of Stow, Ohio—parents Dona and Mark, kids Rachel, Andrew, Laura, Peter, and Timothy—kindly opened their doors (and their drawers) for Leen. The photo shoot took a total of 12 hours from setup to cleanup.

WORLDWIDE

While photographing flickers in Alaska, **Michael Quinton** attracted more than a flicker of interest himself from a passing black bear. "I heard dry leaves rustling, and there he was, 30 feet away," Michael says. "It was the one day I'd forgotten my bear repellent. I yelled at him to leave, and he finally did."

But not for long. A few minutes later, as Michael stood atop a ladder changing film in one of his cameras, he looked down to find that the bear had returned. This time Michael pounded on the ladder's aluminum rungs until the racket scared the animal off. "Not long after, I saw him again, cutting through the trees toward

me," he says. "I'd heard about black bears that might want to stalk you. So I figured I'd better get out of there."

Michael takes bears seriously, but they don't bother him much more than any other hairy, obstreperous neighbor might. He and his family choose to live in an isolated cabin near Alaska's Wrangell-St. Elias National Park. "However," says Michael, "I hear our area's going on the electrical grid next year. We just may have to move."

Staff writer **Karen Lange's** stay in Pawtucket last June should have been a breeze. She'd gone to school just down the road, at Brown University. Later, she

worked as a Peace Corps volunteer in Liberia, and has roughed it in places like Mali and Syria for the *GEOGRAPHIC*. But for most of her time in Rhode Island, "I felt awful," she says. Karen hadn't caught some exotic disease during her travels: She was experiencing morning sickness.

Baby Caroline Anna arrived January 20. Perhaps she'll be a journalist: Having inherited her mom's knack for meeting deadlines, she was born right on time.

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Flashback



GENERAL MOTORS PHOTOGRAPHIC SECTION,
SUBMITTED BY AUTOMOBILE MANUFACTURERS ASSOCIATION

THE END OF CHEAP OIL

Wheel Life Begins

To New Yorkers around 1910, it may have seemed as though all the automobiles in the U.S. had converged on Fifth Avenue. The city had its share of the wealthy, and cars were a rich man's toy. Manhattan also boasted something much of the country lacked: well-paved roads. Those roads were about to get busier.

In 1913 Henry Ford's new factory assembly line made mass production of cars possible. By 1920 about half the 9.2 million vehicles in the United States were Ford Model T's. As supply grew, prices dropped, and automakers offered installment plans to make purchasing cars easier.

But in New York, at least, parking them only got more difficult.

—Margaret G. Zackowitz

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